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DATA PROCESSING PLAN FOR SOLAR MAXIMUM MISSION-A (SMM-A)

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APRIL 1979

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National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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Information Processing Division

April 1979

GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

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GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

DATA PROCESSING PLAN

FOR

SOLAR MAXIMUM MISSION - A
(SMM-A)

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DATA PROCESSING PLAN
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ABSTRACT

This document describes the first Solar Maximum Mission objectives, experiments and experimenters, spacecraft configuration, spacecraft systems, orbit, telecommunications, and ground station operations. This document is principally concerned with the processing procedures used by the Information Processing Division to process telemetry data received from the Solar Maximum Mission-A. The division receives from the network stations telemetry data containing multiplexed spacecraft and experiment data. The data are received in digital form, edited and time annotated, decommutated, recorded on output tapes, and shipped to the SMM-A principal investigators for scientific analysis of the onboard experiments.

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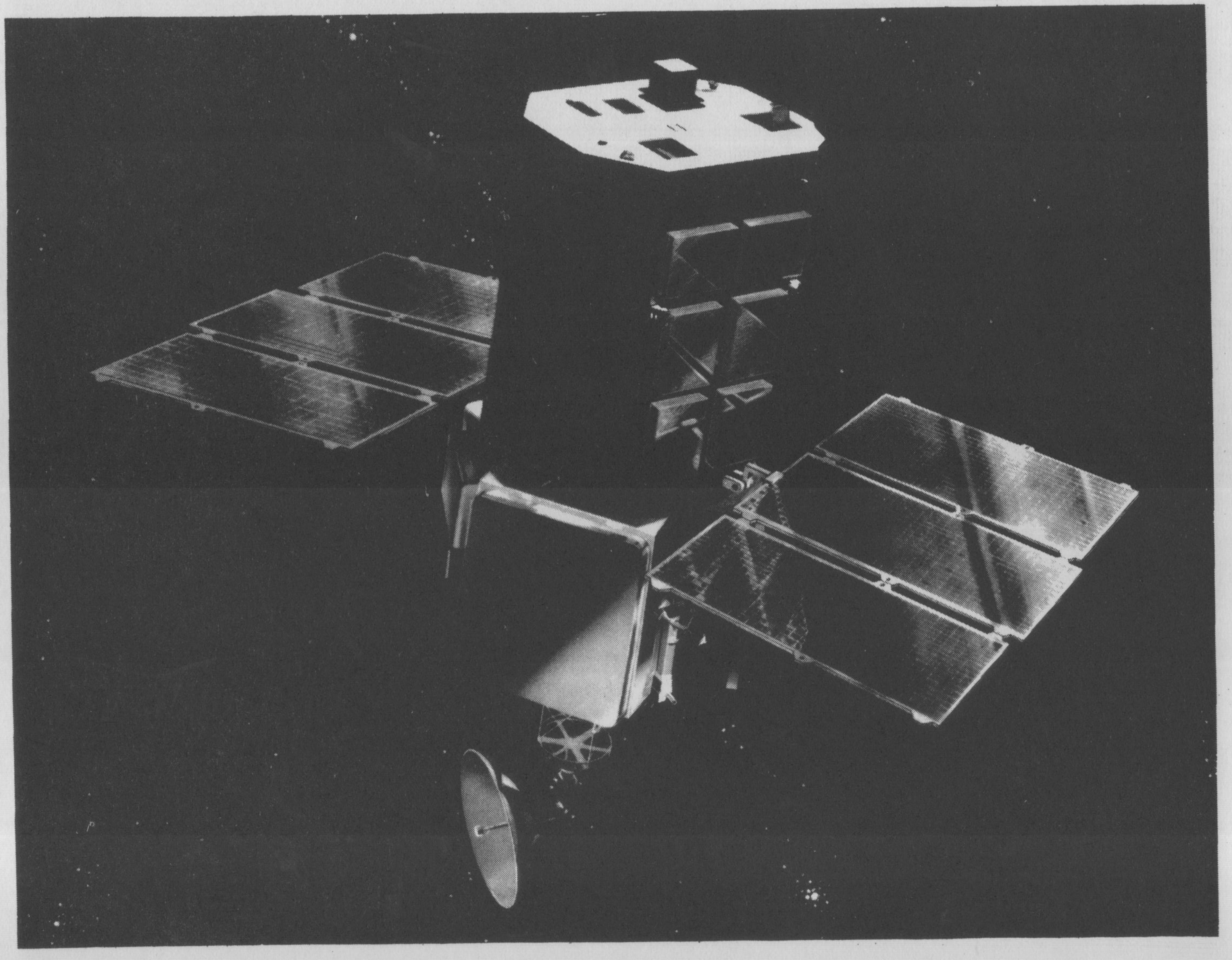
SECTION 1

INTRODUCTION



Frontispiece. SMM-A Spacecraft

DATA PROCESSING PLAN
FOR
SOLAR MAXIMUM MISSION-A
(SMM-A)

1. INTRODUCTION

1.1 GENERAL

The Solar Maximum Mission-A (SMM-A) has been developed to investigate solar flares, flare-related phenomena, and the total irradiance of the Sun, during the next period of maximum solar activity. The SMM-A observatory will observe flares and flare-induced effects in the chromosphere, chromosphere-corona transition region, and corona as manifested by changes in line emission, velocity, and magnetic field. The observatory will study the outer Lyman-Alpha corona and solar wind; and determine the fundamental physical characteristics of the solar plasma in the upper chromosphere, transition region, and inner corona before, during, and after solar flares. The characteristics to be measured or determined are electron temperature and density, flare plasma morphology, magnetic field configuration, material velocities, and relative abundances of elements. The SMM-A will also study coronal evolution at solar maximum and examine the coronal transient activity with particular emphasis on gaining knowledge of the electron density and the role of the coronal magnetic field both in response to the transient event. Further SMM-A observations will determine the temperature and density structure of high-energy flare plasma as a function of space and time and the extent to which the flare plasma departs from the thermal equilibrium, and determine the temperature and density structure of the related active regions, the changes induced by flaring, and the spatial relationship with the flare plasma.

Plans are in effect to launch SMM-A from the Kennedy Space Flight Center (ETR) in October 1979, using a Delta 3910 launch vehicle. The mission life is planned for a duration of at least 12 months.

1.2 MISSION OBJECTIVES

Specific mission objectives of the Solar Maximum Mission-A are:

A. Determine the fundamental characteristics of the solar plasma before, during, and after solar flares

B. Study coronal evolution at solar maximum

C. Determine the temperature density structure of high-energy flare plasma as a function of space and time

D. Investigate the position, structure, and thermodynamic properties of hot-thermal and nonthermal sources in flares

E. Investigate electron acceleration and very high temperature plasmas by observing high energy solar X-rays

F. Determine the spectral and temporal history of proton acceleration in flares from gamma-ray lines; and

G. Measure the total irradiance of the Sun.

The SMM-A mission will be the first NASA mission to employ the Multimission Modular Spacecraft (MMS). The Multimission Modular Spacecraft has been designed for direct support of a variety of intermediate to large automated Earth orbital missions.

1.3 SCIENTIFIC EXPERIMENTS

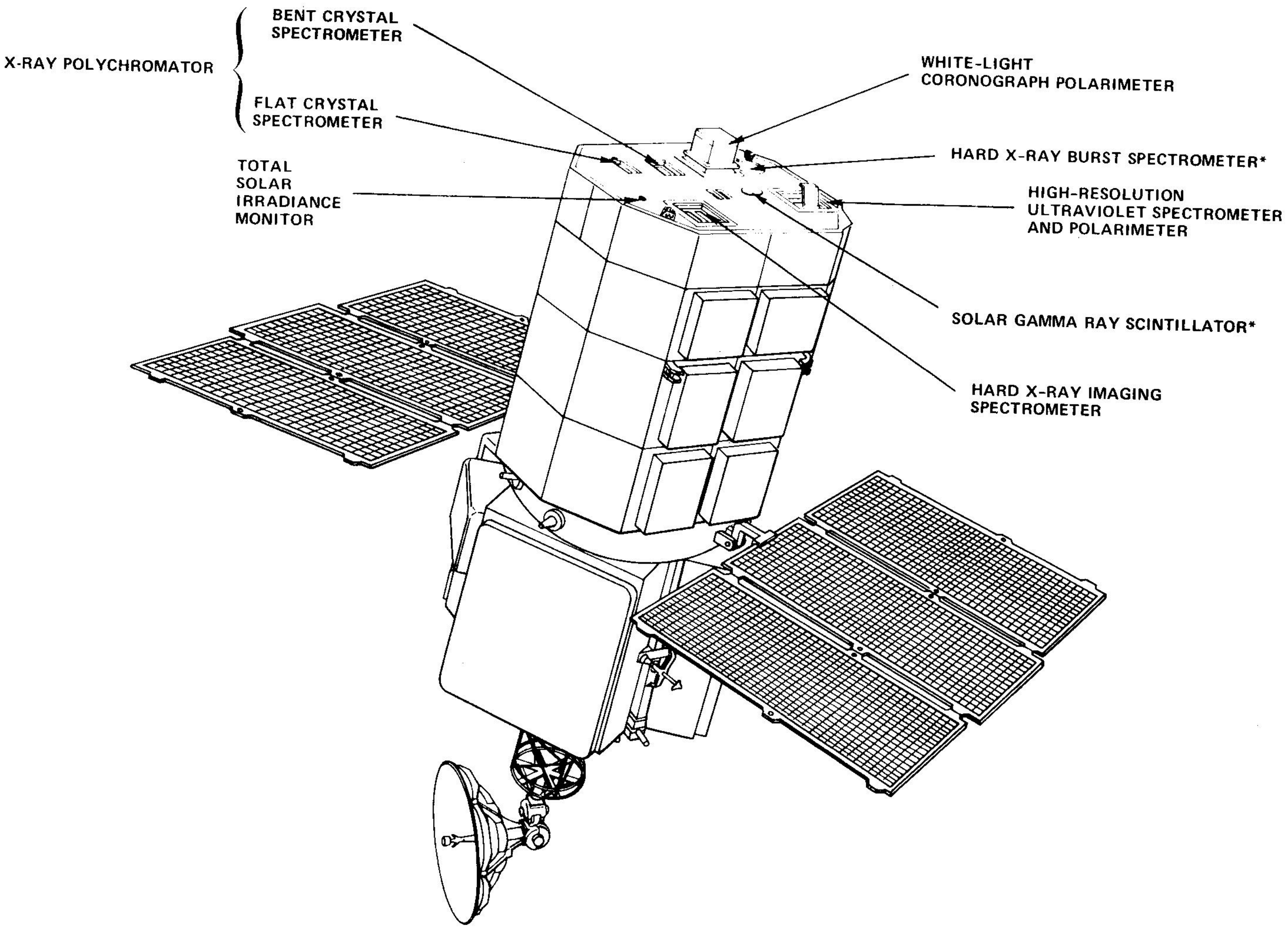
The SMM-A spacecraft will use seven experiments to meet the mission objectives. The experiments are discussed in detail in paragraphs 1.3.1 through 1.3.7. Experiment placement aboard the spacecraft is illustrated in Figure 1-1.

1.3.1 Hard X-ray Imaging Spectrometer

The Hard X-ray Imaging Spectrometer experiment will investigate the position, structure, and properties of hot-thermal and nonthermal sources in active regions and will cover the photon-energy range from 3.5 to 30 keV with spatial resolution of 8 arc-seconds square.

1.3.2 High-resolution UV Spectrometer and Polarimeter

The GSFC/MSFC Ultraviolet Spectrometer and Polarimeter experiment will study the physical conditions of the corona active regions and flares and observe line intensities and profiles in the range from 1100 to 3000 Å. Temperature, density, velocity, and magnetic field measurements will be obtained.


X-RAY POLYCHROMATOR
BENT CRYSTAL SPECTROMETER
FLAT CRYSTAL SPECTROMETER
TOTAL SOLAR IRRADIANCE MONITOR
WHITE-LIGHT CORONOGRAPH POLARIMETER
HARD X-RAY BURST SPECTROMETER*
HIGH-RESOLUTION ULTRAVIOLET SPECTROMETER AND POLARIMETER
SOLAR GAMMA RAY SCINTILLATOR*
HARD X-RAY IMAGING SPECTROMETER

*THESE INSTRUMENTS HAVE NO APERTURE HOLE IN THE FORWARD CLOSEOUT. THEY VIEW THROUGH AN OPAQUE CLOSEOUT PLATE.

Figure 1-1. Experiment Placement Aboard Spacecraft

1.3.3 White-light Coronograph Polarimeter

The High Altitude Observatory White-Light Coronograph/Polarimeter will study coronal evolution at solar maximum with a measurement range from 3800 to 7000 Å. This experiment will also examine coronal transient activity, with particular emphasis on gaining knowledge of the electron density and the role of the coronal magnetic field both in, and in response to, the transient event.

1.3.4 X-ray Polychromator

The Soft X-ray Polychromator will determine the temperature and density structure of the flare plasma as a function of space and time with a measurement range from 1.59 to 22.4 Å; and will determine:

a) the extent to which the flare plasma departs from thermal equilibrium, and

b) temperature and density structure of the related active regions and changes induced by flaring.

1.3.5 Solar Gamma-ray Scintillator

The University of New Hampshire Gamma-ray Scintillator (spectrometer) will study solar gamma rays in the range from 10 KeV to 160 MeV to study dynamics of solar-flare/particle-acceleration phenomena, to identify specific ambient or transient nuclides and determine their abundance.

1.3.6 Hard X-ray Burst Spectrometer

The GSFC Hard X-ray Burst Spectrometer will investigate characteristics of electron acceleration in the solar-flare process in the range from 20 to 300 keV to determine the role that accelerated particles play in generation of the thermal phase of the flare process.

1.3.7 Total Solar Irradiance Monitor

The Total Solar Irradiance Monitor instrument will measure the total and spectral solar irradiance at wavelengths from far ultraviolet to far infrared with an absolute uncertainty approaching 0.1 percent in SI units, a precision of 0.02 percent and projected lifetime instrument uncertainty of less than ±0.2 percent.

1.4 EXPERIMENTERS

The SMM-A experimenters and their affiliation are listed in Table 1-1.

Table 1-1
List of Experimenters

Experiment	Principal Investigator	Affiliation
Hard X-ray Imaging Spectrometer	Dr. C. deJager	Space Research Laboratory, Utrecht
High-resolution UV Spectrometer and Polarimeter	Dr. E. Tandberg-Hanssen	NASA/Marshall Space Flight Center
White-light Coronograph Polarimeter	Dr. R. MacQueen	High Altitude Observatory
X-ray Polychromator	Dr. L. Acton	Lockheed Palo Alto Research Lab.
	Dr. J. L. Culhane	Mullard Space Science Laboratory, UCL
	Dr. A. Gabriel	Appleton Laboratory, Culham
Solar Gamma-ray Spectrometer	Dr. E. Chupp	University of New Hampshire
Hard X-ray Burst Spectrometer	Mr. K. Frost	NASA/Goddard Space Flight Center
Total Solar Irradiance Monitor	Dr. R. Willson	Jet Propulsion Laboratory

SECTION 2

SPACECRAFT DESCRIPTION

2.0 SPACECRAFT DESCRIPTION

2.1 CONFIGURATION

The SMM-A spacecraft consists of the Multimission Modular Spacecraft (MMS) Bus, mission unique components, and instruments (see Figure 2-1). The baseline configuration contains three subsystem modules supported by a Module Support Structure (MSS). A Transition Adapter (T/A) completes the structural elements. The structural system provides the necessary reaction/load paths for all lateral and thrust-axis induced inertial loads. The loads for a Delta vehicle are supported by the base of the MMS; the modules and MSS are cantilevered from the Transition Adapter, which has a capture drogue point that permits the shuttle Orbiter to capture and deploy the spacecraft. To accomplish its scientific objective, the SMM-A is equipped with a three-axis stabilized space observatory to meet the following requirements:

- Ability to point the optical axis of a telescope to any selected point on the solar disc (implies ±16 arc-min. pointing range in each of two axes)
- Pointing accuracy of ±5 arc-s about each of two axes
- Pointing stability of ±3.0 arc-s for more than 5 minutes in each of two axes
- Stabilization accuracy and knowledge of inertial attitude within 0.1° about the third axis (rotation about line-of-sight to Sun)
- Reorientation in response to attitude commands
- Maintenance of inertial attitude memory during orbit night and rapid reacquisition at orbit dawn.

The SMM-A observatory is divided into two major elements (see Figure 2-2):

- The Multimission Modular Spacecraft (MMS) Bus or the "service spacecraft'
- The Mission Uniques or the "Experiment Module."

The MMS spacecraft bus consists of the baseline configuration which consists of three subsystem modules supported by a Module Support Structure (MSS). A Transition Adapter (T/A) completes the structural elements. The structural system provides the necessary reaction/load paths for all lateral and thrust-axis-induced inertial loads. The inertial loads for a Space Transportation

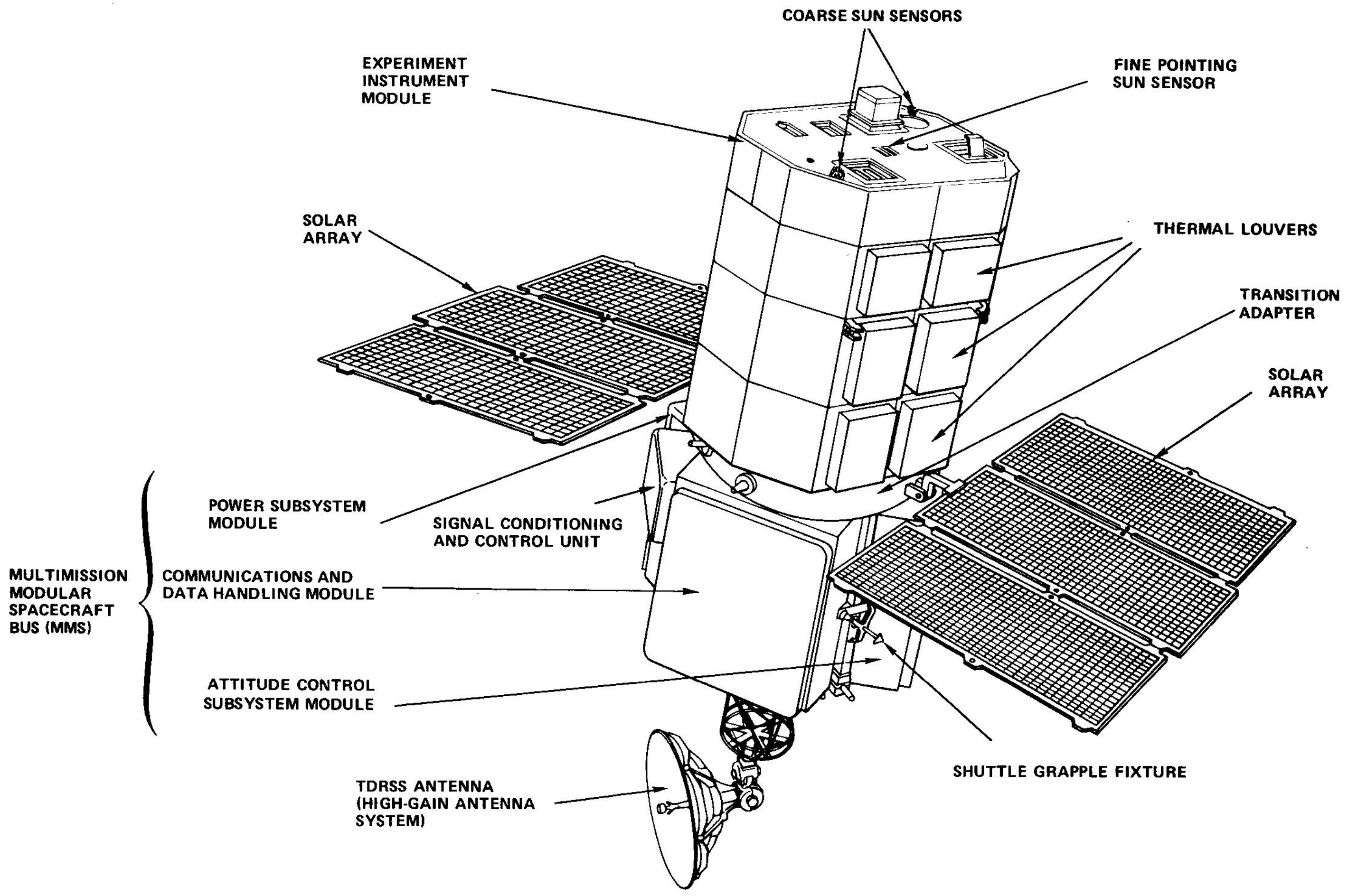

COARSE SUN SENSORS
EXPERIMENT INSTRUMENT MODULE
FINE POINTING SUN SENSOR
SOLAR ARRAY
THERMAL LOUVERS
TRANSITION ADAPTER
SOLAR ARRAY
POWER SUBSYSTEM MODULE
SIGNAL CONDITIONING AND CONTROL UNIT
MULTIMISSION MODULAR SPACECRAFT BUS (MMS)
COMMUNICATIONS AND DATA HANDLING MODULE
ATTITUDE CONTROL SUBSYSTEM MODULE
SHUTTLE GRAPPLE FIXTURE
TDRSS ANTENNA (HIGH-GAIN ANTENNA SYSTEM)

Figure 2-1. SMM-A Spacecraft Configuration

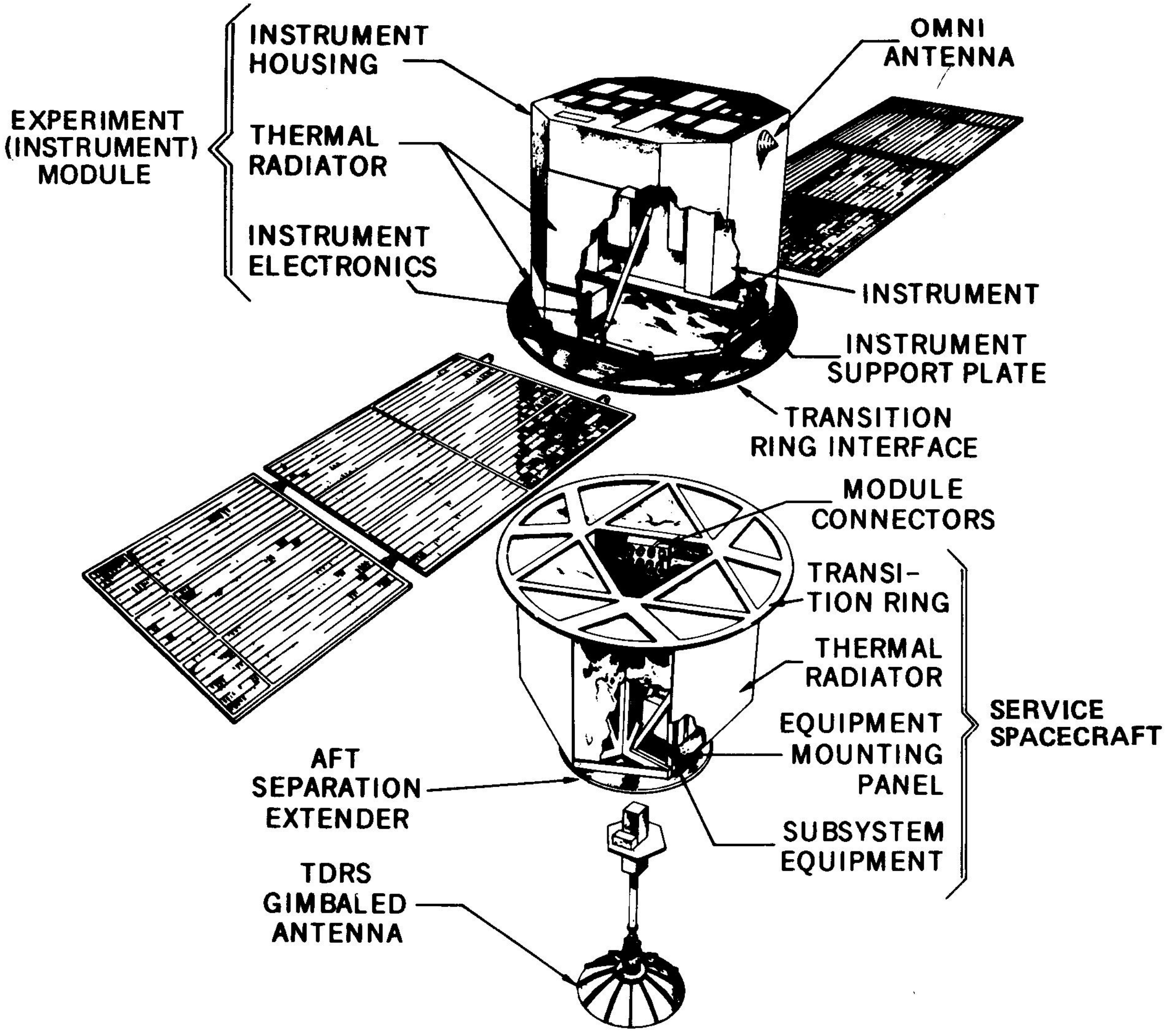


Figure 2-2. Expanded View SMM-A Observatory

System (STS) launch are supported by the T/A. Similarly, the loads for a Delta vehicle are supported by the base of the MMS. The modules and MSS are cantilevered from the T/A. The Transition Adapter has a capture drogue point that permits the shuttle Orbiter to capture and deploy the spacecraft.

The three spacecraft subsystem modules are the same size. They measure 46 cm (18 inches) deep, 122 cm (48 inches) high, and 122 cm (48 inches) wide. The front and side panels are constructed of 2.5-cm (1 inch) thick aluminum alloy honeycomb. A common hole pattern has been established to accommodate the attach points in addition to a set of universal internal gridwork of walls and frames. The front face of the module has a hole pattern for mounting thermal louvers. The modules are attached to the primary load-carrying structure. The total weight of the SMM observatory (MMS bus plus instrument module) will be approximately 4000 lbs. The subsystem modules are:

- Power Subsystem (see Section 2.3.1)
- Attitude Control Subsystem (see Section 2.3.4)
- Communications and Data Handling (see Section 4.2.1)

Mission-unique items for SMM are: instrument module, thermal subsystem, solar array, fine Sun sensor tape recorders (10^8 bits), three 20-Ah batteries, remote interface units, power switching unit, omni S-band antenna, Tracking and Data Relay Satellite System (TDRSS) antenna (HGAS), delta launch-vehicle adapter, and flight mission software. (Each of the mission-unique items are discussed in Sections 2.3, 3.1, and 4.1.)

2.2 CHARACTERISTICS

General

	kg
Spacecraft Weight	592.4 (1306 lbs)
Instrument Weight	567.5 (1251 lbs)
Mission Unique	103.9 (229 lbs)
Instrument Module	283.0 (624 lbs)
Total Observatory (Launch Configuration)	1580.8 (3485 lbs)

Spacecraft shape

Depth	46 cm (18")
Width	122 cm (48")
Height	122 cm (48")

Telemetry System

- Transmitter

Bandwidth	6 MHz
Power	5 watts
Modulation	PM (STDN); SQPSK

- Receiver

Bandwidth	6 MHz
Frequency stability	0.005%
Sensitivity	N/A
Tuning	Fixed phase lock to received signal

- Antenna

Frequency range	2.1 to 2.3 GHz
Polarization	RHCP (OMNI); LHCP (TDRSS)
Gain	-7 dBi (OMNI); +23/+9 dBi (TDRSS)
Beamwidth	4 (OMNI), 8 deg. (TDRSS)

Command System

- Receiver

Bandwidth	6 MHz
Frequency stability	0.005%
Sensitivity	.134 dBm
Tuning	fixed phase lock to receive signal

- Antenna

Frequency range	2.1 to 2.3 GHz
Polarization	RHCP (OMNI); LHCP (TDRSS)
Gain	-7 dBi (OMNI); +23/+9 dBi (TDRSS)
Beamwidth	4 (OMNI); 8 deg (TDRSS)

Tracking System

- Transmitter

Bandwidth	6 MHz
Power	5 watts
Modulation	PM (STDN); SQPSK (TDRSS)

- Receiver

Bandwidth	6 MHz
Frequency stability	0.005%
Sensitivity	.136 dBm

- Antenna

Frequency range	2.1 to 2.3 GHz
Polarization	RHCP (OMNI); LHCP (TDRSS)
Gain	-7 dBi (OMNI); +23/+9 dBi (TDRSS)
Beamwidth	4 (OMNI); 8 deg (TDRSS)

2.3 SYSTEMS

2.3.1 Power Subsystem

The power subsystem is an unregulated system operating at 28 ±7 Vdc negative ground. The primary source of power is a solar array consisting of deployable paddles mounted to the spacecraft structure. Power during eclipse is supplied by nickel-cadmium batteries that are connected to the load bus. The batteries are charged and discharged in parallel. Temperature-sensing resistors are built into the batteries to supply thermal information to the power-regulator unit to maintain the appropriate battery charge control voltage. The SMM-A satellite will carry three 20-Ah nickel-cadmium batteries of 22 cells each. Because the baseline MMS carries only two batteries, the requirement for a third battery makes the third battery "mission unique." Thus, 60-Ah capacity will be provided as required with a design depth of discharge of 23.7 percent. A third electrode in each battery will monitor the overcharge condition of the battery. Adequate battery capacity must be included for: (a) powering the spacecraft for up to five orbits immediately after launch, and (b) sustaining nominal loads during the eclipses of approximately 36 minutes for 2 years. In addition to spacecraft loads, the power subsystem must be able to support up to 200 watts of daylight experiment power and up to 50 watts of nighttime experiment power.

The Power Switching Unit (PSU) contains the distribution busses that supply power to the payload and instrument platform heaters. Three completely redundant busses are provided—a quiet main bus, a pulse load bus, and a heater power bus. Fuse protection is provided on each output power bus. Current sensors are included in the PSU to monitor the current supplied by each of the three busses.

2.3.2 Thermal Control System

The thermal subsystem of the SMM experiment module uses heaters and appropriate surface coatings to maintain instrument and electronics temperature within acceptable limits. A thermal enclosure provides for a low-gradient heat sink for the instruments, which radiate directly to it. In addition, much of the instrument electronics will be mounted to the enclosure, thereby removing gradient-producing heat dissipators from the vicinity of the instrument support plate.

2.3.3 Solar Array

The solar paddles, which are electrically interfaced with the MMS power module, are flat panels that deploy to a fixed position. The arrays are externally mounted to the SMM transition-ring body and will provide approximately 1540 watts at end of life.

2.3.4 Attitude Control Subsystem

The SMM-A will be a three-axis stabilized spacecraft with the attitude controlled by onboard computer processing of sensor information to supply the appropriate updates to the reaction-wheel system. Control of solar pointing in two axes shall be maintained through the use of optical sensor updating of the inertially referenced servo control loops in azimuth and elevation. The primary function of the Attitude Control Subsystem (ACS) is to orient and stabilize the spacecraft relative to a desired target. The central control system element is an onboard computer that processes all sensor-derived information and, in conjunction with various types of stored information, generates the appropriate control signals to operate the reaction control devices. The onboard computer, which is shared with other spacecraft subsystems, is physically located in the communication and data handling module. A backup control loop independent of the computer, is provided to ensure the capability of shuttle retrieval or resupply if anomalous behaviour of the computer occurs. With the exception of coarse Sun sensors and mission-unique fine-error sensors that are incorporated into payload instruments, all control sensors are housed in the ACS module.

All normal operational modes are implemented with the onboard computer. The ACS sensor complement consists of a high performance Inertial Reference Unit (IRU), a pair of strapped down (electronic scanning) star trackers, 2 three-axis magnetometer sets, and a complement of Sun sensors. The information generated by these sensors is available to the computer for supporting the various operational modes. The IRU errors are removed by means of rate and attitude correction factors developed in the onboard computer on the basis of information obtained from the optical sensors. The magnetometers are used to identify the relationship of the Earth's magnetic field relative to the spacecraft. This information is used with Sun-sensor attitude information to make attitude determinations, primarily in support of initial acquisition. The magnetometer data are also used with reaction-wheel speed data to excite magnetic torquers for continuously removing accumulated momentum from the reaction wheels. The Sun-sensor complement consists of two sets of coarse analog Sun sensors located on the thermal enclosure, one redundant fine pointing Sun sensor mounted on the instrument support plate, and one precision digital Sun sensor located in the ACS module. The Sun-sensor complement is as follows:

- A coarse Sun-sensor and a three-axis magnetometer shall provide data for coarse (±2° to ±5°) attitude information. Two star sensors will provide data for fine (1 arc-min.) attitude information. In addition, a fine-pointing Sun sensor (redundant unit provided) with 5 arc-second accuracy will be used for maintaining servo control of the spacecraft pitch and yaw axes.

- A Fine-Pointing Sun Sensor: Two Fine-Pointing Sun Sensors (one prime and one redundant) will provide attitude information in two orthogonal axes for solar pointing to an accuracy of 5 arc-seconds. They are to be mounted on a flat reference surface and provided with an optical cube for alignment. The null of the sensor shall be defined by the alignment cube. The center of the Sun may be defined as either the geometric centroid of the solar disk or the radiometric centroid in the spectral range of detector sensitivity. The sensor will resolve the angular offset of the Sun center from the sensor null in two axes. Outputs will be digital and will not be affected by Sun intensity variation. The Sun-sensor assemblies will be packaged into separate optics and electronic units.

2.4 LAUNCH AND ORBIT

The SMM-A spacecraft is to be launched in October, 1979, from the Kennedy Space Flight Center (ETR) and placed into a near-circular 574-km (310 nm) orbit with an inclination of 28.5°. A minimum scientific lifetime of one year is planned and subsequently the satellite is to be retrieved and returned to Earth by the NASA Space Shuttle in 1981.

The Delta launch-vehicle Separation Adapter is designed to interface with the Multimission Modular Spacecraft three-point mount. The Delta launch-vehicle is illustrated in Figure 2-3.

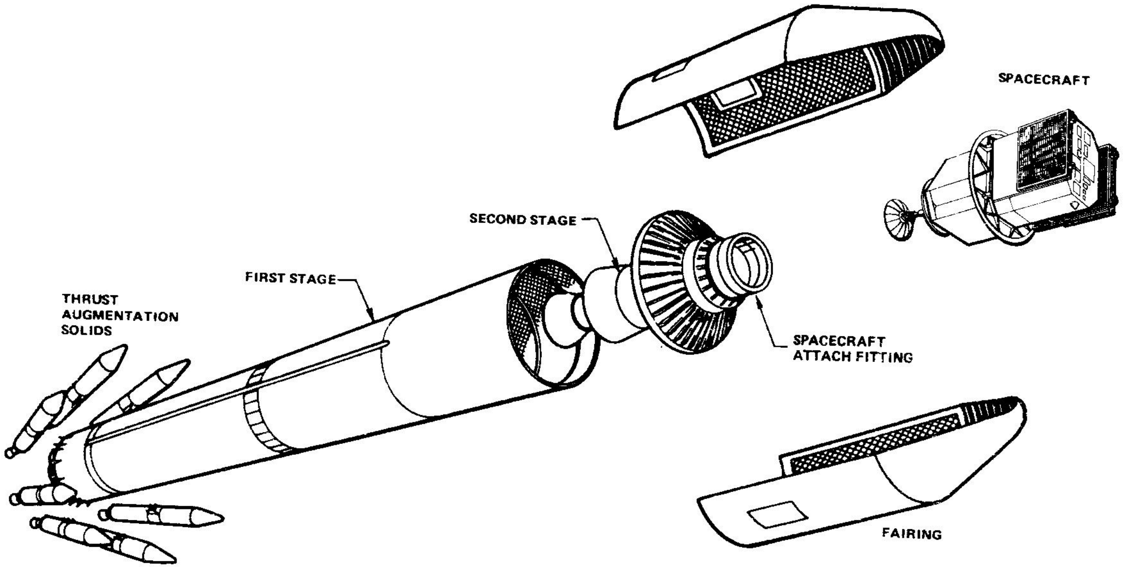


Figure 2-3. Delta Launch Vehicle/Spacecraft Separation Schematic

SECTION 3

TELECOMMUNICATIONS

3.0 TELECOMMUNICATIONS

3.1 DATA HANDLING

The SMM-A spacecraft will use NASA standard transponders to communicate with the Ground Station Tracking and Data Network (GSTDN). In addition, the SMM-A spacecraft has been designed to be compatible with the forthcoming Tracking and Data Relay Satellite System (TDRSS). Once TDRSS becomes operational, SMM-A spacecraft communications can be transmitted via TDRSS, or, directly between the spacecraft and the Ground Station Tracking and Data Network. An omni-type antenna system is used for links to GSTDN, and a mechanically steered directional antenna (as well as the omni) is used for links to TDRSS. The GSTDN command rate is 2 kbps, and the ranging system is the standard GSTDN system. TDRSS command rates are 125 and 1000 bps, and TDRSS ranging is by the TDRSS coded spread-spectrum. For both GSTDN and TDRSS, telemetry formats consist of 16 kbps (1 kbps with TDRSS is emergency mode) real-time telemetry alone or in combination with one of the following: computer dump at 32 kbps (1 kbps with TDRSS in emergency mode) spacecraft tape recorder playback at 512 kbps (might be reduced with TDRSS to 256 kbps because of link margins), HAO tape recorder playback at 512 kbps (might be reduced with TDRSS to 256 kbps because of link margins), or HAO real-time data at 256 kbps. TDRSS link telemetry is convolutionally encoded, and all communications operations are at the TDRSS multiple-access frequencies. Tape-recorder dumps via TDRSS require scheduling of single-access support. GSTDN stations that can support SMM will be utilized when required; during the early operations phase, more than one GSTDN contact per orbit will be scheduled as available. When normal operations are achieved, a minimum of one GSTDN contact per orbit will be required to accomplish routine command and data acquisition, but there will be unpredictable periods requiring more than one contact per orbit. These periods will generally occur when there is a rapid turnaround requirement to support solar flare activities and also when large command programs must be uplinked to the five onboard computers. During suspected solar flare activity, tape recorder dumps should be played back to the Experimenter Operations Facility (EOF) immediately after the station pass.

3.1.1 Tape Recorder

The SMM-A spacecraft will house two spacecraft tape recorders to provide onboard bulk data storage. Each recorder can store approximately four full orbits of telemetry data. A telemetry bit rate of 16 kbps for recording will be maintained. The NASA standard tape recorder currently being developed with a capacity of 4.5×10^8 bits meets all SMM requirements and has been selected for use on SMM-A. A third tape recorder is being provided for the dedicated use by the High Altitude Observatory (HAO) Instrument.

3.1.2 Radio Frequency System

The Radio Frequency (RF) combiner box permits commands to be received through either of the two antenna systems. Choice of a particular system is dependent on the High-Gain Antenna System (HGAS) pointing and polarization of the signal. In addition, the hybrid will ensure that no deep nulls occur in the region where the omni coverage hemispheres merge. A functional block diagram of the RF system, (including the HGAS, the RF combiner, and the Communications and Data Handling interface) is shown in Figure 3-1.

3.1.3 Antenna Array

- High-Gain Antenna System: The HGAS consists of a bi-axially gimbaled antenna and associated drive electronics. Antenna pointing is accomplished via commands from the onboard computer. Slewing rates will be controlled to minimize spacecraft attitude perturbations. The HGAS is an integral part in communicating via TDRSS.

- Omni S-Band Antenna: The S-band antenna system consists of a pair of S-band hemispheric coverage antennas mounted so that each antenna has 180-degree coverage in opposite hemispheres. The antenna pattern is expected to be uniform, except in the equatorial plane where the hemispheres meet; in this region nulls are expected to be no worse than -11 dB.

3.2 COMMAND SYSTEM

The command group for SMM-A is one segment of the spacecraft's communications and data handling equipment. Standard Telemetry and Command Components (STACC) will be used. The STACC design is based on the concept of remote multiplexing of telemetry data and remote distribution of commands. Command and telemetry data are routed to and from other spacecraft and instrument subsystems by a serial digital, multiplex data bus to minimize interconnections. When needed, signal conditioning of passive transducers is provided by a constant current source that is applied to the devices at the time of sampling. The standard predetermined science and engineering (one each) telemetry formats are controlled by read-only memories. In the event of failure during the mission, a new telemetry format may be generated by the onboard computer.

The basic command rate is a Shuttle-compatible 2000 bps with 48 bits per word. This rate will be used when commanding from STDN; however, command rates of 1000 and 125 bps are provided and will be used when commanding through TDRSS single-access and multiple-access channels.

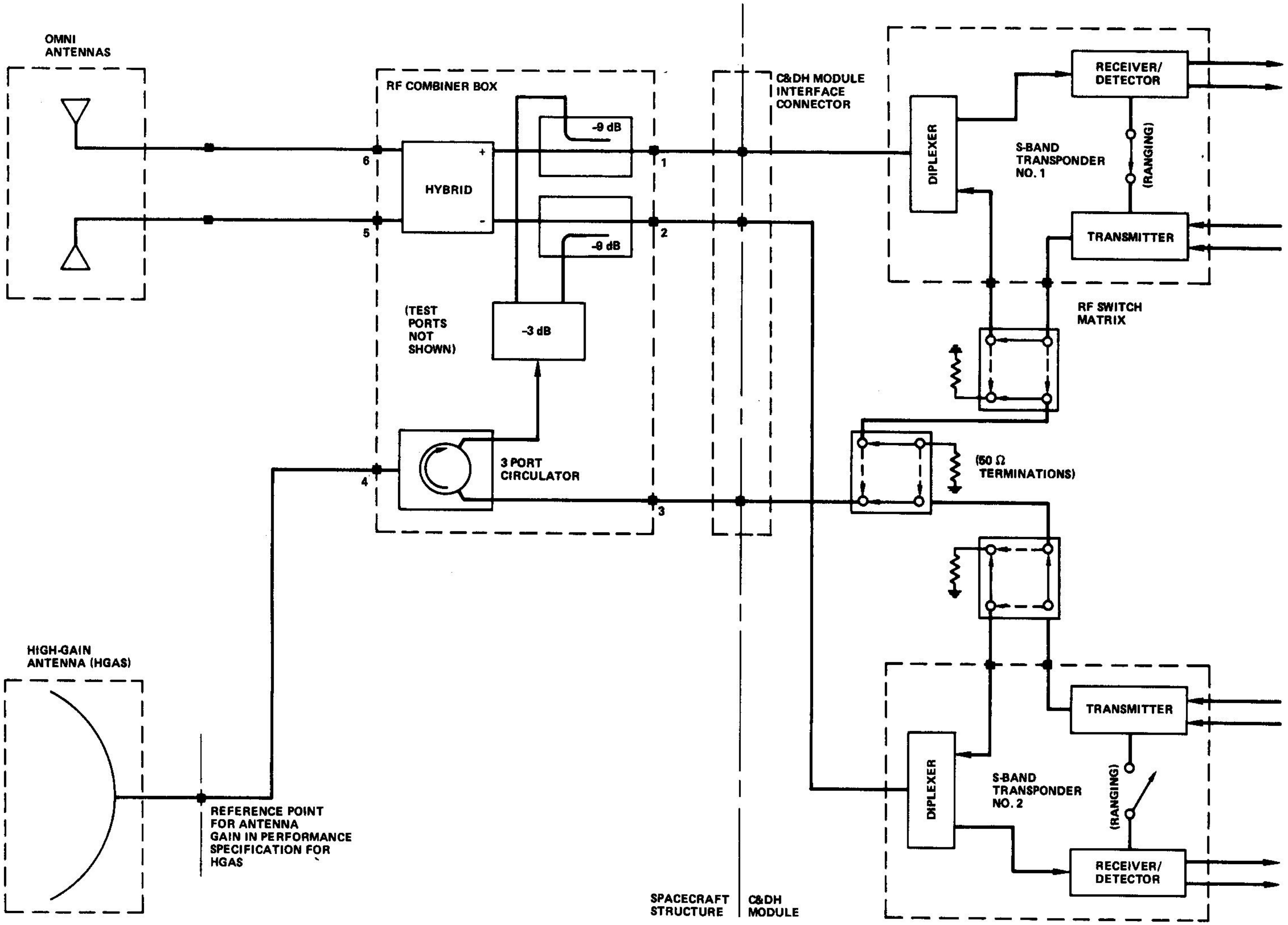


Figure 3-1. SMM-A Radio Frequency System

Tables 3-1 to 3-4 list the telemetry formats, and telemetry assignments for the Command and Data Handling System.

The Remote Interface Units (RIU) handle communications between the Central Unit (CU) of the Standard Telemetry and Command Components (STACC) and the instruments via Multiplex Data Bus (MDB). The CU transmits instruction messages to the RIU over a Supervisory Line. The RIU transmits data return messages over a Reply Line. The RIU, as instructed by the CU instruction message, will perform one of the following three functions:

(1) Decode and distribute commands to the instruments.

(2) Decode and distribute selected clock signals to the instruments.

(3) Accept, condition, format, and transmit instrument telemetry data. This includes supplying all necessary control and conditioning signals to the instrument to effect data transfer.

Table 3-1
SMM-A Minor Frame Telemetry Format Mode 2 (Science Format)

MINOR FRAME WORD NR.	DESCRIPTION	ID
00	FRAME SYNC WORD	CDH 01
01	FRAME SYNC WORD	CDH 01
02	FRAME SYNC WORD	CDH 01
03	TLM FORMAT, RATE & ID	CDH 56
04	SCIENCE DATA	HXIS 04
05	SCIENCE DATA	HXIS 04
06	SCIENCE DATA	HXRBS 22
07	SCIENCE DATA	HXRBS 23
08	UNASSIGNED	SMM
09	UNASSIGNED	SMM
10	SCIENCE DATA	XRP 01
11	SCIENCE DATA	XRP 01
12	DATA SOURCE 1	GRE 26
13	DATA SOURCE 1	GRE 26
14	SCIENCE DATA	HXIS 04
15	SCIENCE DATA	HXIS 04
16	FPSS 1 WORD 1	SACS 01
17	FPSS 1 WORD 2	SACS 02
18	FPSS 1 WORD 3	SACS 03
19	FPSS 1 WORD 4	SACS 04
20	SCIENCE DATA	HXIS 04
21	SCIENCE DATA	HXIS 04
22	PHOTODIODE 1	HXIS 24
23	ANE STATUS 3	HXIS 07
24	SCIENCE DATA	HXIS 04
25	SCIENCE DATA	HXIS 04
26	SCIENCE DATA	XRP 01
27	DMA ADDRESS	UVSP 05
28	DMA DATA	UVSP 06
29	STATUS MONITOR	UVSP 07
30	DATA BUS 2	UVSP 01
31	DATA BUS 2	UVSP 01
32	SUBCOMMUTATOR NR 1	CDH 06
33	SUBCOMMUTATOR NR 2	CDH 07
34	RECEIVER STATUS	CDH 12
35	OBC DATA WORD ID	OBC 01
36	SCIENCE DATA	HXIS 04
37	SCIENCE DATA	HXIS 04
38	SCIENCE DATA	HXRBS 24
39	SCIENCE DATA	HXRBS 25
40	SCIENCE DATA	HXIS 04

Table 3-1 (continued)

MINOR FRAME WORD NR.	DESCRIPTION	ID
41	SCIENCE DATA	HXIS 04
42	SCIENCE DATA	XRP 01
43	SCIENCE DATA	XRP 01
44	DATA SOURCE 1	GRE 26
45	DATA SOURCE 1	GRE 26
46	SCIENCE DATA	HXIS 04
47	SCIENCE DATA	HXIS 04
48	FPSS 2 WORD 1	SACS 05
49	FPSS 2 WORD 2	SACS 06
50	FPSS 2 WORD 3	SACS 07
51	FPSS 2 WORD 4	SACS 08
52	SCIENCE DATA	HXIS 04
53	SCIENCE DATA	HXIS 04
54	SCIENCE DATA	HXRBS 26
55	SCIENCE DATA	HXRBS 27
56	SCIENCE DATA	HXIS 04
57	SCIENCE DATA	HXIS 04
58	SCIENCE DATA	XRP 01
59	SCIENCE DATA	XRP 01
60		
61		
62	DATA BUS 3	UVSP 02
63	DATA BUS 3	UVSP 02
64	S/C CLOCK BITS 7-0	CDH 02
65	FRAME COUNTER	CDH 03
66	CMD COUNTER (SELECTED CU)	CDH 04
67	DWELL MODE & CHANNEL ID	CDH 05
68	SCIENCE DATA	HXIS 04
69	SCIENCE DATA	HXIS 04
70	SCIENCE DATA	HXRBS 28
71	SCIENCE DATA	HXRBS 29
72	SCIENCE DATA	HXIS 04
73	SCIENCE DATA	HXIS 04
74	SCIENCE DATA	XRP 01
75	SCIENCE DATA	XRP 01
76	DATA SOURCE 2	GRE 27
77	DATA SOURCE 3	GRE 28
78	SCIENCE/HSKPG SUBCOM	WLCP 10
79	SCIENCE DATA	HXIS 04
80	OBC DATA WORD 1	OBC 02

Table 3-1 (continued)

MINOR FRAME WORD NR.	DESCRIPTION	ID
81	OBC DATA WORD 2	OBC 03
82	OBC DATA WORD 3	OBC 04
83	OBC DATA WORD 4	OBC 05
84	SCIENCE DATA	HXIS 04
85	SCIENCE DATA	HXIS 04
86	S/C CLOCK BITS 15-8	SMM
87	S/C CLOCK BITS 23-16	SMM
88	SCIENCE DATA	HXIS 04
89	SCIENCE DATA	HXIS 04
90	SCIENCE DATA	HXIS 04
91	SCIENCE DATA	HXIS 04
92	SCIENCE DATA	HXIS 04
93	SLLRA (COMP SHLD)	HXRBS 34
94	DATA BUS 2	UVSP 03
95	DATA BUS 2	UVSP 03
96	SUBCOMMUTATOR NR 3	CDH 08
97	SUBCOMMUTATOR NR 4	CDH 09
98	SUBCOMMUTATOR NR 5	CDH 10
99	SUBCOMMUTATOR NR 6	CDH 11
100	SCIENCE DATA	HXIS 04
101	SCIENCE DATA	HXIS 04
102	SCIENCE DATA	HXRBS 30
103	SCIENCE DATA	HXRBS 31
104	SCIENCE DATA	HXIS 04
105	SCIENCE DATA	HXIS 04
106	SCIENCE DATA	XRP 01
107	SCIENCE DATA	XRP 01
108	SCIENCE DATA	ACRIM 01
109	SUBCOM WORD	XRP 02
110	SCIENCE DATA	HXIS 04
111	SCIENCE DATA	HXIS 04
112	OBC DATA WORD 5	OBC 06
113	OBC DATA WORD 6	OBC 07
114	OBC DATA WORD 7	OBC 08
115	OBC DATA WORD 8	OBC 09
116	SCIENCE DATA	HXIS 04
117	SCIENCE DATA	HXIS 04
118	SCIENCE DATA	HXRBS 32
119	SCIENCE DATA	HXRBS 33
120	SCIENCE DATA	HXIS 04
121	SCIENCE DATA	HXIS 04
122	SCIENCE DATA	XRP 01
123	SCIENCE DATA	XRP 01
124		
125		
126	DATA BUS 3	UVSP 04
127	DATA BUS 3	UVSP 04

Table 3-2
Fixed Word Assignments

Word No.	Bit No.	FUNCTION	DEFINITION
0-2		FRAME SYNC WORDS	SEE TABLE 3-3
3	0,1,2	BIT RATE	SEE TABLE 3-3
	3,4	FORMAT ID	SEE TABLE 3-3
	5	CENTRAL UNIT A/B	SEE TABLE 3-3
	6	R/T OR OBC DUMP DATA	SEE TABLE 3-3
	7	CU SIGNAL PRESENCE	SEE TABLE 3-3
32		SUBCOM NR 1	
33		SUBCOM NR 2	
34	0	RCVR A LOCK STATUS	0= UNLOCKED 1= LOCKED
	1	RCVR A TDRSS/GSTDN MODE	0= STDN 1= TDRSS
	2	RCVR B LOCK STATUS	0= UNLOCKED 1= LOCKED
	3	RCVR B TDRSS/GSTDN MODE	0= GSTDN 1= TDRSS
	4	DET A LOCK STATUS	0= LOCKED 1= UNLOCKED
	5	DET B LOCK STATUS	0= LOCKED 1= UNLOCKED
	6	CU A COMMAND REJECT	0= ACCEPT 1= REJECT
	7	CU B COMMAND REJECT	0= ACCEPT 1= REJECT
35		OBC DATA WORD ID	
64		S/C CLOCK (8 LSB OF SEL CU)	1 BIT = 1.024 SEC
65		FRAME COUNTER (0-127)	1 BIT = 64 MS (1 MINOR FRAME at 16 KBPS) (1.024 SEC AT 1 KBPS)
66		COMMAND COUNTER (0-255) (OF SELECTED CU)	
67	0	DWELL MODE STATUS	0= OFF 1= ON
	1-7	DWELL CHANNEL ID (0-127)	
96-99		SUBCOMS 3-6	

Table 3-3
Frame Synchronization Pattern

MINOR FRAME WORD NUMBER	BIT NUMBER	BIT STATE	DEFINITION
WORD 0	0	1	FRAME SYNC
	1	1	FRAME SYNC
	2	1	FRAME SYNC
	3	1	FRAME SYNC
	4	1	FRAME SYNC
	5	0	FRAME SYNC
	6	1	FRAME SYNC
	7	0	FRAME SYNC
WORD 1	0	1	FRAME SYNC
	1	1	FRAME SYNC
	2	1	FRAME SYNC
	3	1	FRAME SYNC
	4	0	FRAME SYNC
	5	0	FRAME SYNC
	6	1	FRAME SYNC
	7	1	FRAME SYNC
WORD 2	0	0	FRAME SYNC
	1	0	FRAME SYNC
	2	1	FRAME SYNC
	3	0	FRAME SYNC
	4	0	FRAME SYNC
	5	0	FRAME SYNC
	6	0	FRAME SYNC
	7	0	FRAME SYNC
WORD 3	012	000	BIT RATE- 1 KBPS
	012	001	BIT RATE- 2 KBPS
	012	010	BIT RATE- 4 KBPS
	012	011	BIT RATE- 8 KBPS
	012	100	BIT RATE- 16 KBPS (SMM-A REAL-TIME DATA)
	012	101	BIT RATE- 32 KBPS
	012	110	BIT RATE- 64 KBPS
	012	111	BIT RATE-128 KBPS (NOT USED ON SMM)
	34	00	HAO R/T OR T/R DATA (SMM ONLY)
	34	01	FORMAT ID ROM ENGINEERING FORMAT
	34	10	FORMAT ID ROM SCIENCE FORMAT
	34	11	FORMAT ID OBC FLEXIBLE FORMAT
	5		CENTRAL UNIT A/B 0=A 1=B
	6		R/T OR OBC DUMP 0=OBC 1=R/T
	7		CU DECODER CH A 0=NO REJ 1=REJECT

Table 3-4
Telemetry Assignments for the Command and Data Handling Subsystem

User ID	Telemetry Function Description	Minor Frame Word	
		Mode 1	Mode 2
CDH 01	MF SYNC 8 MSB	00	00
	8 NEXT MSB	01	01
	8 LSB	02	02
CDH 02	S/C CLOCK 8 MSB	96 (81)	96 (81) 87
	S/C CLOCK 8 NEXT MSB	97 (81)	97 (81) 86
	S/C CLOCK 8 LSB	64	64
CDH 03	MINOR FRAME COUNTER	65	65
CDH 04	CMD COUNTER SELECTED CU	66	66
CDH 05	DWELL MODE ID & CH	67	67
CDH 06	SUBCOM 1 SMM	32	32
CDH 07	SUBCOM 2 SMM	33	33
CDH 08	SUBCOM 3 MMS	96	96
CDH 09	SUBCOM 4 MMS	97	97
CDH 10	SUBCOM 5 MMS	98	98
CDH 11	SUBCOM 6 SMM	99	99
CDH 12	BILEVEL WORD 010 (RCVR STATUS)	34	34
CDH 13	BILEVEL WORD 020	96 (120)	96 (120)
CDH 14	BILEVEL WORD 040	97 (120)	97 (120)
CDH 15	BILEVEL WORD 050	98 (120)	98 (120)
CDH 16	BILEVEL WORD 060	96 (121)	96 (121)
CDH 17	BILEVEL WORD 070	97 (121)	97 (121)
CDH 18	BILEVEL WORD 110	96 (37) 96 (103) 111	96 (37) 96 (103)
CDH 19	BILEVEL WORD 130	98 (121) 88	98 (121)
CDH 20	BILEVEL WORD 140	96 (122)	96 (122)
CDH 21	BILEVEL WORD 150	97 (122)	97 (122)
CDH 22	BILEVEL WORD 160	98 (122)	98 (122)
CDH 23	BILEVEL WORD 170	96 (123)	96 (123)

Table 3-4 (continued)

User ID	Telemetry Function Description	Minor Frame Word	
		Mode 1	Mode 2
CDH 24	PMP A STATUS	96 (78)	96 (78)
CDH 25	PMP B STATUS	97 (78)	97 (78)
CDH 26	PMP TEMP	98 (35)	98 (35)
CDH 27	CU A TEMP	98 (80)	98 (80)
CDH 28	CU B TEMP	98 (81)	98 (81)
CDH 29	PCU TEMP	98 (36)	98 (36)
CDH 30	RIU A TEMP	96 (83)	96 (83)
CDH 31	RIU B TEMP	96 (84)	96 (84)
CDH 32	RIU A/B INTRA TEMP	96 (80)	96 (80)
CDH 33	STINT A TEMP	97 (83)	97 (83)
CDH 34	STINT B TEMP	97 (84)	98 (84)
CDH 35	STINT A STATUS	98 (83)	98 (83)
CDH 36	STINT B STATUS	98 (84)	98 (84)
CDH 37	STBY CU CMD COUNTER	96 (82)	96 (82)
		91	
CDH 38	XPNDR A TCXO TEMP	96 (36)	96 (36)
CDH 39	XPNDR A PWR AMP TEMP	98 (33)	98 (33)
CDH 40	XPNDR A AGC LEVEL	96 (38)	96 (38)
		96 (104)	96 (104)
		89	
CDH 41	XPNDR A RF FWD PWR	96 (34)	96 (34)
CDH 42	XPNDR A RF REF PWR	96 (35)	96 (35)
CDH 43	XPNDR B TCXO TEMP	97 (36)	97 (36)
CDH 44	XPNDR B PWR AMP TEMP	98 (34)	98 (34)
CDH 45	XPNDR B AGC LEVEL	97 (38)	97 (38)
		97 (104)	97 (104)
		90	
CDH 46	XPNDR B RF FWD PWR	97 (34)	97 (34)
CDH 47	XPNDR A RF REF PWR	97 (35)	97 (35)
CDH 48	MOD TEMP +X MEM 4 & 5	97 (79)	97 (79)
CDH 49	MOD TEMP +Y	97 (80)	97 (80)
CDH 50	MOD TEMP -Y	98 (79)	98 (79)
CDH 51	+28V UNREG BUS	97 (37)	97 (37)
		97 (103)	97 (103)
		92	
CDH 52	MEM 0 & 3 INTRA TEMP	96 (79)	96 (79)
CDH 53	CU A FLEX FORM LOAD/VERIFY	97 (82)	97 (82)
CDH 54	CU B FLEX FORM LOAD/VERIFY	98 (82)	98 (82)
CDH 55	TLM RATE, FORMAT, ID	03	03

3.3 PROJECT DATA FORMATS

The project data formats (PDF's) for SMM-A are as follows:

- PDF-A is designed to contain real-time 16 kbps data in a forward direction.
- PDF-B handles the 32 kbps onboard computer data dump, and is sent simultaneously with format A in a forward direction to GSFC.
- PDF-C handles High Altitude Observatory (HAO) real-time data at 256 kbps, as a backup mode of operation in the event that the HAO recorder becomes inoperative. These data will be input to the Digital Data Processing System (DDPS) at 128 kbps and transmitted to GSFC in the forward direction.
- PDF-D contains spacecraft recorder dump data at 512 kbps (these data will be analog recorded and input to the DDPS at 128 kbps, and transmitted to GSFC in reverse order).
- PDF-E contains HAO recorder dump data at 512 kbps (these data will be analog recorded and input to the DDPS at 128 kbps, and transmitted in reverse order).
- PDF-F contains spacecraft recorder dump data, with the same characteristics as PDF-D except the transfer to DDPS is at 256 kbps.
- PDF-G's HAO recorder dump data have the same characteristics as PDF-E except the transfer to DDPS is at 256 kbps.
- PDF-H will contain spacecraft recorder dump data at 512 kbps (data will be analog recorded and played back in reverse order at a 12:1 reduced speed from the recorder). The playback data rate of the analog tape will be 42.666 kbps.
- PDF-I contains HAO recorder dump data at 512 kbps (data will be analog recorded and played back in reverse order at 12:1 reduced speed from the recorder; the playback data rate of the analog type will be 42.666 kbps).
- PDF-J contains spacecraft recorder dump data at 512 kbps (data will be analog recorded and played back in reverse order at 6:1 reduced speed from the recorder). The playback data rate of the analog tape will be 85.333 kbps.

- PDF-K contains HAO recorder dump data at 512 kbps (data will be analog recorded and played back in reverse order at 6:1 reduced speed from the recorder). The playback data rate of the analog tape will be 85.333 kbps.

- PDF-L will be real-time data at 1 kbps. This is an emergency format and will be used to sync the OBC dump in the event it gets out of main frame sync with the real-time 16 kbps data (data will be in a forward direction and should be transmitted off station of 1 block per second).

PDF's C, D, and E can be direct from an analog tape or from digital tapes.

SECTION 4

GROUND OPERATIONS

4.0 GROUND OPERATIONS

4.1 DATA ACQUISITION

The Networks Directorate (ND) support facilities, which include the Ground Spaceflight Tracking and Data Network (GSTDN) and ground communications between NASA supporting facilities, will be responsible for data acquisition, tracking, and command support requirements. Support by the GSTDN stations is contingent on the operational availability of the specified stations during station simulations and during the mission. Because of circumstances beyond the control of the ND, some stations may not be available; however, the GSTDN configurations existing at the time will be used. Tracking, data acquisition, and command transmissions will be scheduled by the Network Operations Control Center (NOCC).

The NOCC will provide operational control of the GSTDN stations in meeting the spacecraft mission requirements of the ND. The NOCC will monitor station status and determine the availability of network resources for scheduling tracking, telemetry data acquisition, and command activities of the STDN stations. These activities will be scheduled in accordance with station capabilities and scheduling requests received from the SMM OCC.

The STDN stations assigned to support SMM-A, and the area of support for which they are responsible, are provided in Table 4-1. Mission support requirements for GSTDN for the first several months of mission are:

- All GSTDN stations that can support SMM will be utilized when required.
- During the early operations phase, more than one GSTDN contact per orbit will be scheduled as available and required.
- When normal operation is achieved, a minimum of one GSTDN contact per orbit will be required to accomplish routine command and data acquisition, but there will be unpredictable periods requiring more than one contact per orbit. These periods will generally occur when there is a rapid turnaround requirement to support solar flare activities and also when large command programs must be uplinked to the five on-board computers. When the phaseover to TDRSS operations becomes acceptable and complete, it can be assumed that GSTDN support will no longer be required on a routine basis. However, if for any reason TDRSS support is reduced below an acceptable level, then backup or emergency support from GSTDN will be required.

Table 4-1
SMM-A Station Support Assignments

Station	Assignments							
	Delta LV		SC Launch/Early Orbit			SC Mission Orbit		
	S-band TLM	C-band TRK	S-band TLM	S-band CMD	S-band TRK	S-band TLM	S-band CMD	S-band TRK
ACN	X	-	X	X	X	X	X	X
AGO	-	-	X	X	X	X	X	X
BDA	X	X	X	X	X	X	X	X
GDS	-	-	X	X	X	X	X	X
GWM	-	-	X	X	X	X	X	X
HAW	-	-	X	X	X	X	X	X
MAD	-	-	X	X	X	X	X	X
MIL	X	-	X	X	X	X	X	X
ORR	-	-	X	X	X	X	X	X
QUI	-	-	X	X	X	X	X	X
TDRS	-	-	-	-	-	X	X	X

Telemetry data acquisition requirements for the Tracking and Data Relay Satellite System (TDRSS) are illustrated in Table 4-2.

4.2 COMMUNICATIONS SYSTEM

The ground communication services provided to selected GSTDN stations, and the project/experimenter unique circuits and facilities are provided by the NASA Communications (NASCOM) Division. The project-unique circuits, and the ground communications service to the GSTDN stations are listed in Table 4-3.

4.2.1 Communications and Data Handling

The Communications and Data Handling (C&DH) for the Multimission Modular Spacecraft (MMS) provides a means for ground and onboard control of all spacecraft and sensor functions and for retrieval of spacecraft housekeeping and sensor data. This subsystem consists of the communications equipment (i.e., RF transmitters and receivers) and data handling equipment that is composed of a command group, a telemetry group, an onboard computer (OBC), and an oscillator with stability characteristics of six parts (or better) in 10^8 per day. Redundancy is provided in the basic subsystem by standby spare equipment. Three tape recorders are flown on SMM. Communication with the spacecraft is achieved through use of omnidirectional (GSTDN operations) and directional (TDRSS operations) antennas and the NASA standard STDN/TDRSS transponder. A functional block diagram of the C&DH subsystem is illustrated in Figure 4-1.

4.2.2 Additional Special Requirements

The High Altitude Observatory (HAO) instrument will generate four unique telemetry formats as follows (production data processing by IPD are required for all four formats):

- Dwell-mode Format. The spacecraft telemetry system could be operated in the HAO dwell mode an estimated one orbit per calendar day. Because two orbits of data could be dumped per playback, both normal and dwell-mode data will be contained in a single tape-recorder playback.

- Instrument Tape-recorder Format. The HAO instrument will have a dedicated tape recorder (identical to the spacecraft recorders) for storing and playing back solar corona images. It is planned to fill this tape recorder once or twice per calendar day, which will require two (or four) GSTDN passes for playback. The HAO data will be recorded in bursts ranging in duration from 3.6 to 30 seconds. Playback is in reverse time order at 512 kbps for both GSTDN and TDRSS operations.

Table 4-2
Telemetry Data Acquisition Requirements for TDRSS

Channel Frequency	Channel Data Rate	Support Interval (Time, position or flight phase)	Real-Time Requirement	Purpose and Remarks
2287.50 MHz	Carrier 16 kbps	One station pass per orbit	Control Center and Experiment Operations Facility	Control of Spacecraft and Experiments
2287.50 MHz	1.024-MHz 32 kbps	One station pass per orbit (duration of dump is several seconds)	Control Center	Dump of onboard computer status buffer for reporting of OBC activities and verification of uplinked programs and/or loads
2287.50 MHz	1.024-MHz subcarrier 512 kbps	One station pass every orbit (duration of a one-orbit dump is approximately 3.3 minutes)	None	Dump of spacecraft tape recorders
2287.50 MHz	1.024-MHz subcarrier 512 kbps	Minimum of two station (four desired) passes per calendar day (duration of a dump is approximately 7.5 minutes)	None	Dump of HAO Instrument tape recorder. Production data processing consists of the data capture function.
2287.50 MHz	1.024-MHz 256 kbps	TBD, backup only in the event of failure of the HAO tape recorder	None	Real-time readout of HAO image data. The HAO tape recorder is by passed and data are acquired during real-time passes only. Production data processing is required and consists of the data capture function
2287.50 MHz	"I" channel 16 kbps	Minimum 30 minutes/orbit every orbit	Control Center and Experiment Operations Facility	Real-time data for control of spacecraft and experiments
2287.50 MHz	"Q" channel 32 kbps	Approximately several seconds per orbit every orbit	Control Center only	Dump of onboard computer for reporting of computer-controlled activities and verification of uplinked programs and/or loads
2287.50 MHz	"Q" channel 512 kbps	Approximately 20 minutes of single access service every four orbits (duration of tape recorder dump is approximately 15 minutes) is required	IPD and Experiment Operations Facility	Dump of spacecraft tape recorder.
2287.50 MHz	"Q" channel 512 kbps	Minimum of 20 minutes (40 minutes desired) of single access service per calendar day is required.	IPD and Experiment Operations Facility	Dump of HAO instrument tape recorder
2287.50 MHz	"I" and "Q" channels 1.0 kbps	As required	Control Center only	Emergency mode only due to loss of SMM high-gain antenna pointing
2287.50 MHz	"Q" channel 256 kbps	TBD, backup only in the event of failure of the HAO tape recorder	IPD and Experiment Operations Facility	Real-time readout of HAO image data

Table 4-3
Ground Communications

Type of Service	Location of Operating Terminals	Bandwidth	Data Rates	Purpose
Wideband	Selected STDN stations-GSFC	56 kbps three channels	16 kbps 32 kbps 128 kbps	Real-time data OBC dump data Tape recorder playback data (post pass)
Wideband	TDRSS-GSFC	1.544 Mbps one channel	16 kbps 32 kbps 512 kbps 512 kbps	Real-time data OBC dump data HAO tape recorder data S/C tape recorder data
*Voice/data	● U. of New Hampshire-GSFC	9.6 kbps one channel	9.6 kbps	Transmission of experiment quick-look data from IPD to U. of New Hampshire
	● High altitude observatory (Boulder, CO)-GSFC	4.8 kbps	4.8 kbps	Transmission of experiment quick-look data from Experiment Operations Facility to Boulder, Colorado
Voice	Selected STDN stations-GSFC	3 kHz One Channel		
Voice	TDRSS station-GSFC	3 kHz		Operational coordination
*Voice/facsimile or wire photo	Worldwide solar forecasting network (primarily NOAA)	To be Determined	TBD	Transmission of ground-based solar pictures

*Project funded circuits

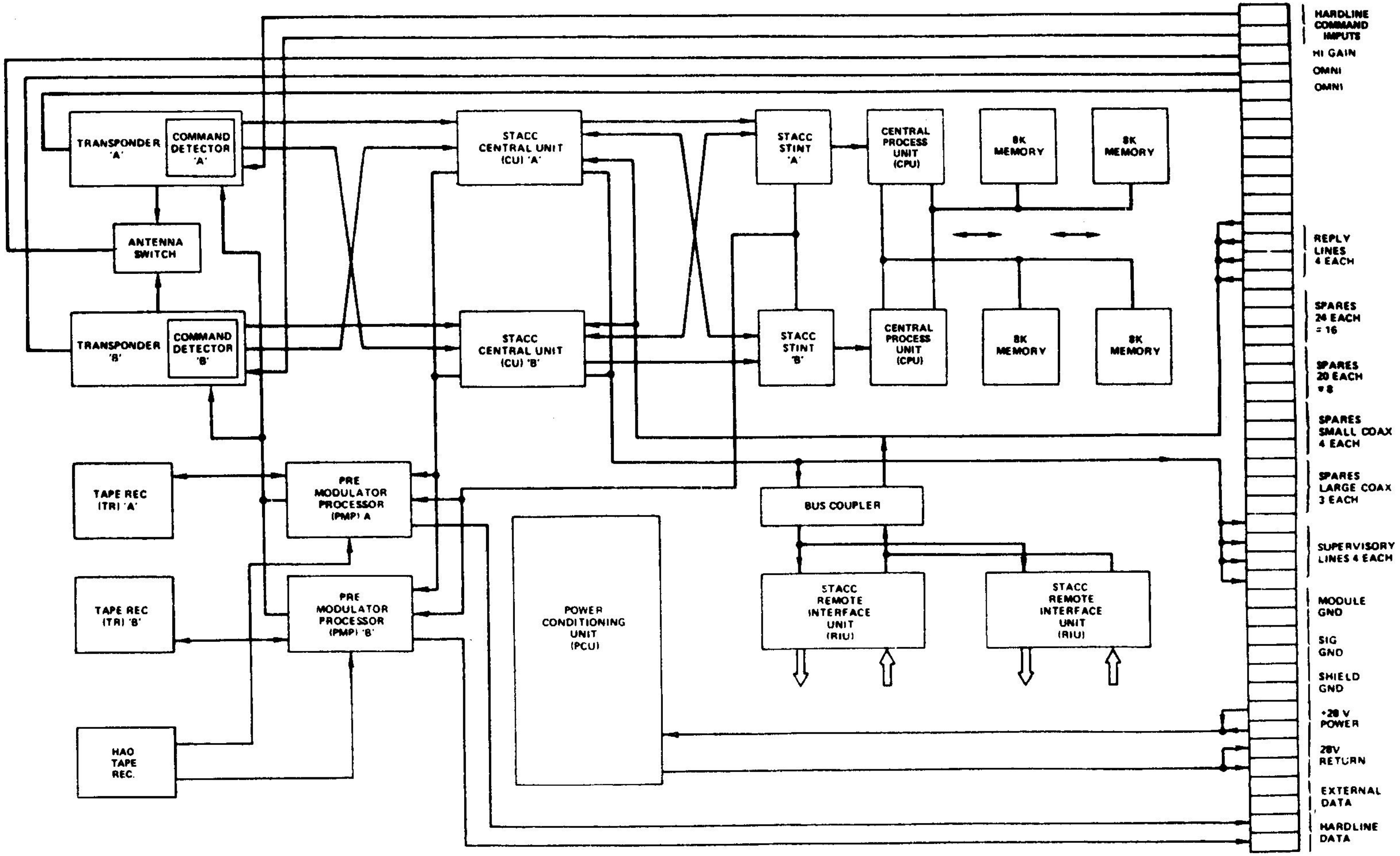


Figure 4-1. C&DH Subsystem Block Diagram Module Interface

Format of the data is identical to the spacecraft format only in word length, minor frame length, and minor-frame synchronization pattern. The format does not contain spacecraft "fixed" words; in particular, the format does not contain the spacecraft clock. The format contains an HAO-unique clock and additional unique housekeeping information.

- Normal-mode Format. The HAO instrument is allocated one minor frame word in the normal-mode format. Data will be output in the normal-mode format whenever the instrument is "ON" and not operating in the dwell.

- Real-time Format. The HAO tape recorder is bypassed, and image data are readout directly in real-time and in forward time sequence at 256 kbps. This is a backup mode only and will be the prime science gathering mode in the event of a failure of the HAO tape recorder.

SECTION 5

DATA PROCESSING

5.0 DATA PROCESSING

5.1 REQUIREMENTS

The Information Processing Division (IPD) at the Goddard Space Flight Center (GSFC) will be responsible for the data processing support to be provided by the Mission and Data Operations Directorate (M&DOD) for the SMM-A mission. Two types of processing, production and quick-look, will be conducted to provide both quick-look and final data to the SMM-A principal investigators and co-investigators.

- Production processing—complete and chronological processing of all acquired spacecraft tape recorder data. Final data tapes will be shipped to principal investigators and co-investigators.
- Quick-look processing—will provide for electronic data transmission to the University of New Hampshire, Durham, N.H. One scheduled playback orbit per day will be selected for quick-look transmission and will be transmitted within 24 hours of data acquisition at GSFC.

5.2 PRODUCTION PROCESSING

5.2.1 General

Production processing will consist of processing all playback data to produce a complete and chronological data base for the final scientific analysis. The playback data will be reversed and edited into major telemetry frames. Telemetry format changes will be detected and identified for later decommutation processing. Time annotation to an accuracy of ±10 milliseconds or better will be performed to correlate the data with the actual sample time. The data base will be decommutated to produce experimenter data tapes compatible with the computer facilities of the experimenters.

The experimenter data tapes will contain the following information:

- Experiment minor frame data
- Experiment subcommutator data
- Spacecraft minor frame data
- Spacecraft subcommutator data

- Flag fields indicating fill or noisy data
- GMT annotation of data to an accuracy of ±10 milliseconds or better

The production data tapes will be shipped to the experimenters within 30 days after the receipt of the data from the GSTDN or TDRSS stations.

5.2.2 Production Data Flow

Upon receipt of the SMM telemetry data, the GSTDN or TDRSS ground stations will digitize the data, format the data into NASCOM message blocks, and transmit the data to the IPD via NASCOM communication lines. The overall data flow for SMM-A production processing is shown in Figure 5-1.

The Telemetry On-line Processing System (TELOPS) will be used to process all SMM-A data. The TELOPS system provides an efficient, highly automated means of processing satellite telemetry data at GSFC. The data are received through an IBM 370 Input Processor System (IP) and stored in temporary hold files. A pre-edit program performs preliminary error detection and quality evaluation on all transmitted SMM-A station messages and reverses the playback data. The data are then stored in a large mass storage system (MSS). The functions of editing and time annotation, decommutation, and quick-look processing of the data will be performed by the UNIVAC 1108 Intermediate Processor System (IT). These functions will be performed for SMM by programs running as user programs under the UNIVAC 1108 EXEC-8 operating system and will be referred to as application programs (AP). The coordination of data for processing with an applications program, the scheduling of processing, the transfer of data from the MSS, and the disposition of the results will be directed by the UNIVAC 1108 TELOPS. The UNIVAC 1108 TELOPS is known as the Intermediate Processor Control System (ITCS) and runs under the general EXEC-8 System. A generalized data flow for the TELOPS environment is shown in Figure 5-2.

5.2.3 Input Processing and Transfer File Processing

The IPD TELOPS input processing system will accept the SMM-A data from the GSTDN stations and place the data into a raw-data file. Figure 5-3 shows the data flow for the input processing. A separation and merge program will collect the data for each project data format (PDF) and will check the data for correct transmission and also request retransmission of data blocks that were lost or were unacceptable. Ten PDF's will be processed by TELOPS for SMM-A: Spacecraft real-time data (PDF-A), spacecraft playback data (PDF's D, F, H, and J), HAO coronograph playback data (PDF's E, G, I, and K), and HAO coronograph real time data (PDF-C). Figures 5-4 and 5-5 illustrate the NASCOM block format of the real-time and the playback data.

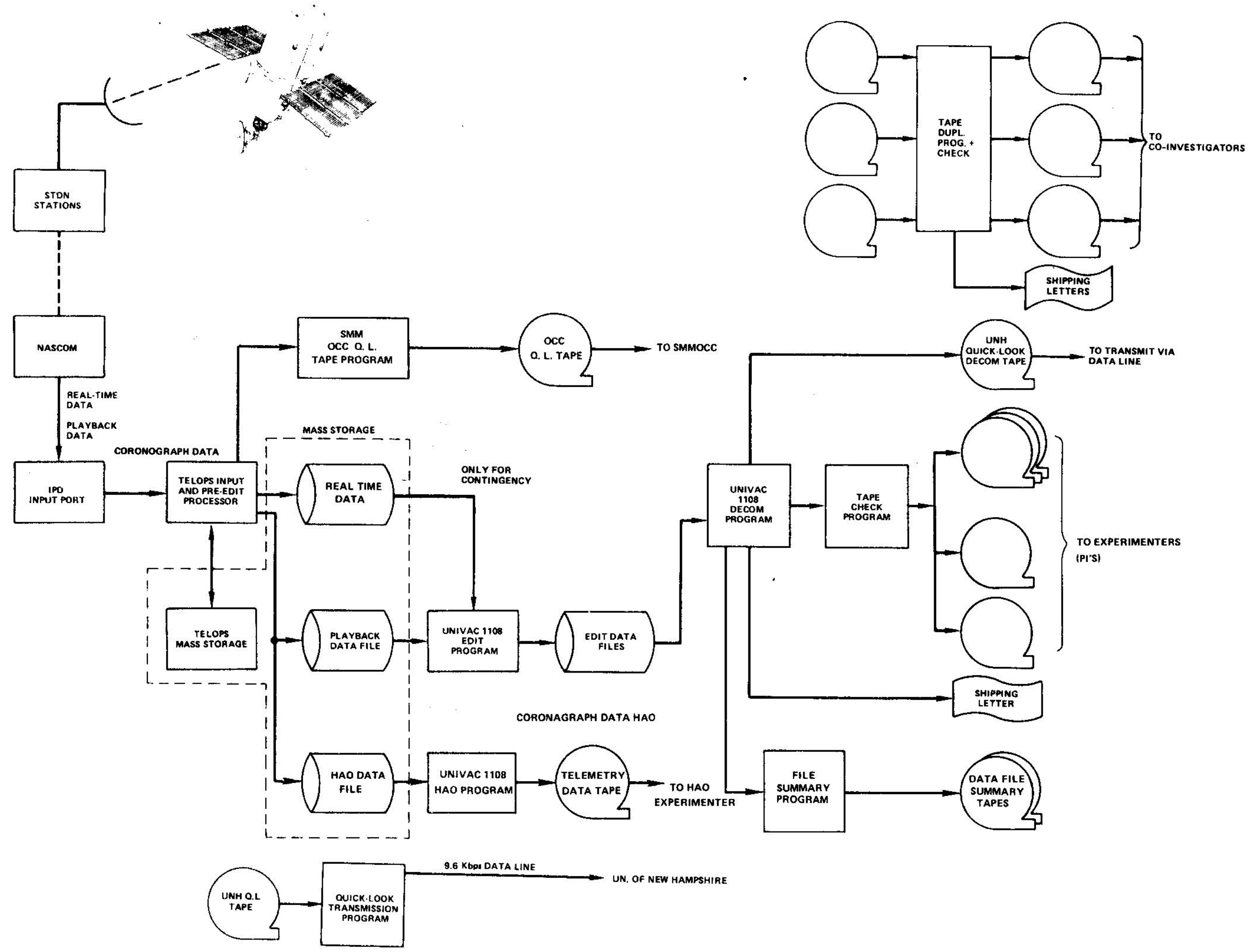


Figure 5-1. SMM-A Data Flow for Production and Quick-look Processing

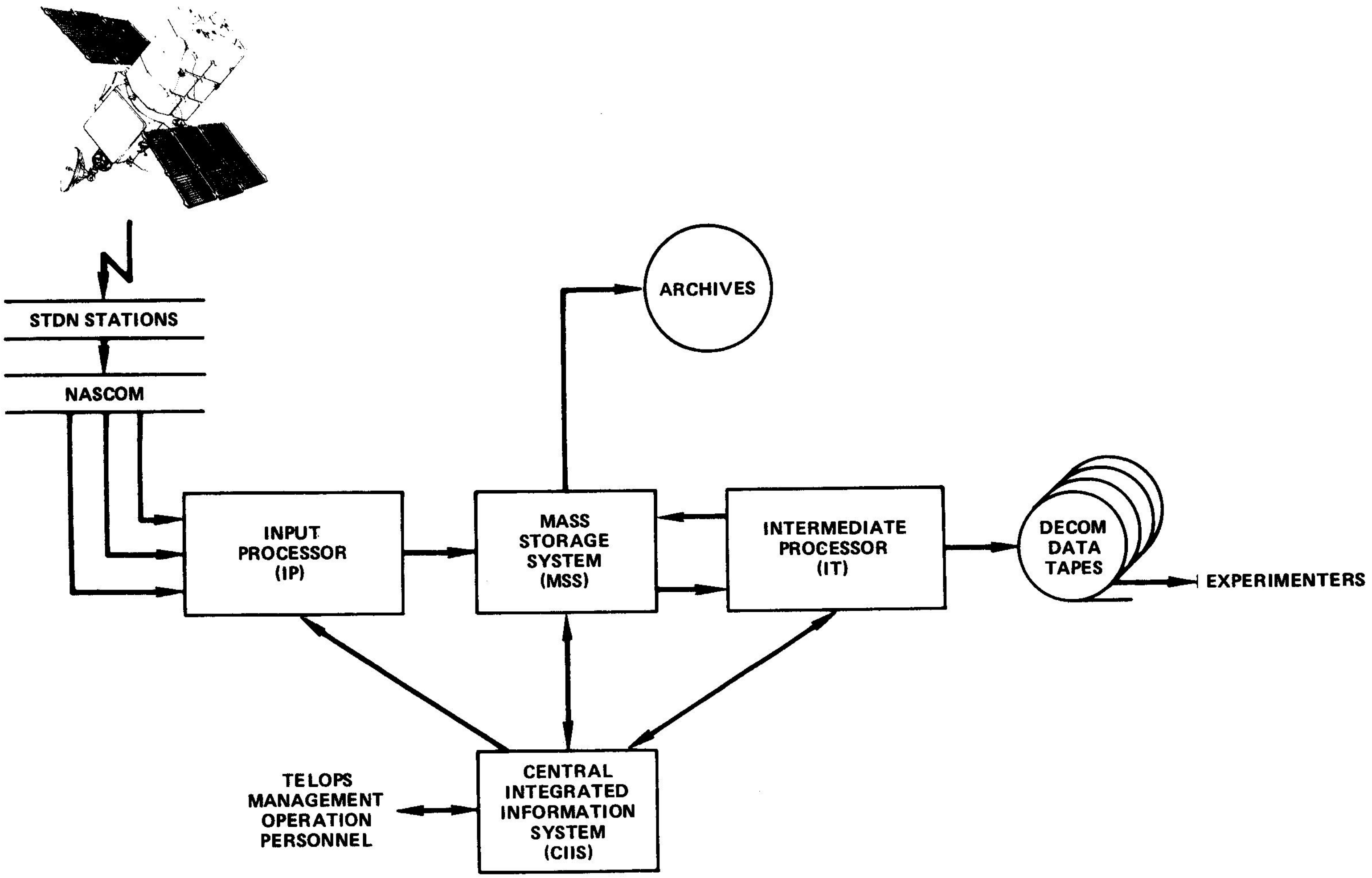

STDN STATIONS
NASCOM
INPUT PROCESSOR (IP)
MASS STORAGE SYSTEM (MSS)
ARCHIVES
INTERMEDIATE PROCESSOR (IT)
DECOM DATA TAPES
EXPERIMENTERS
TELOPS MANAGEMENT OPERATION PERSONNEL
CENTRAL INTEGRATED INFORMATION SYSTEM (CIIS)

Figure 5-2. Data Flow under TELOPS Environment

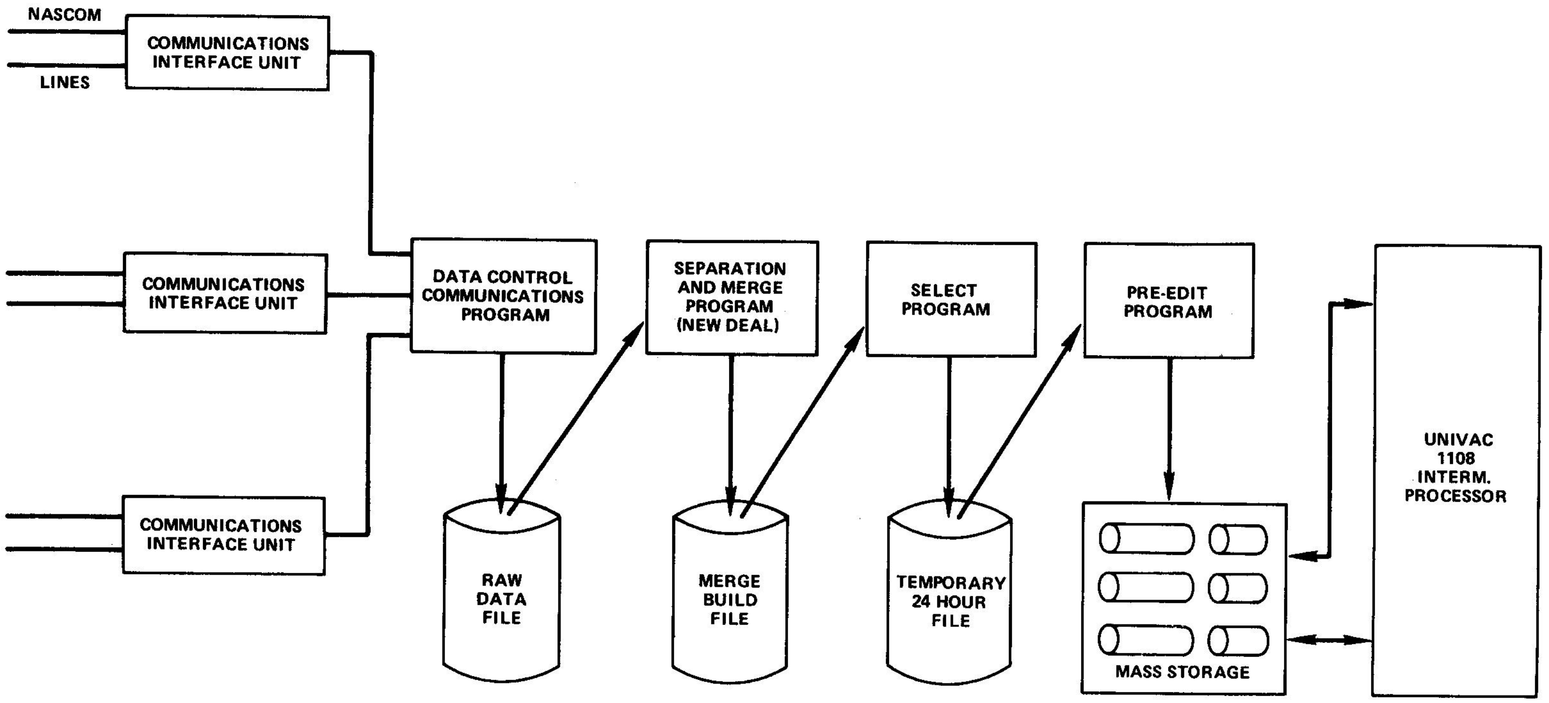

NASCOM
LINES
COMMUNICATIONS INTERFACE UNIT
COMMUNICATIONS INTERFACE UNIT
COMMUNICATIONS INTERFACE UNIT
DATA CONTROL COMMUNICATIONS PROGRAM
RAW DATA FILE
SEPARATION AND MERGE PROGRAM (NEW DEAL)
MERGE BUILD FILE
SELECT PROGRAM
TEMPORARY 24 HOUR FILE
PRE-EDIT PROGRAM
MASS STORAGE
UNIVAC 1108 INTERM. PROCESSOR

Figure 5-3. Data Flow for Input Processing

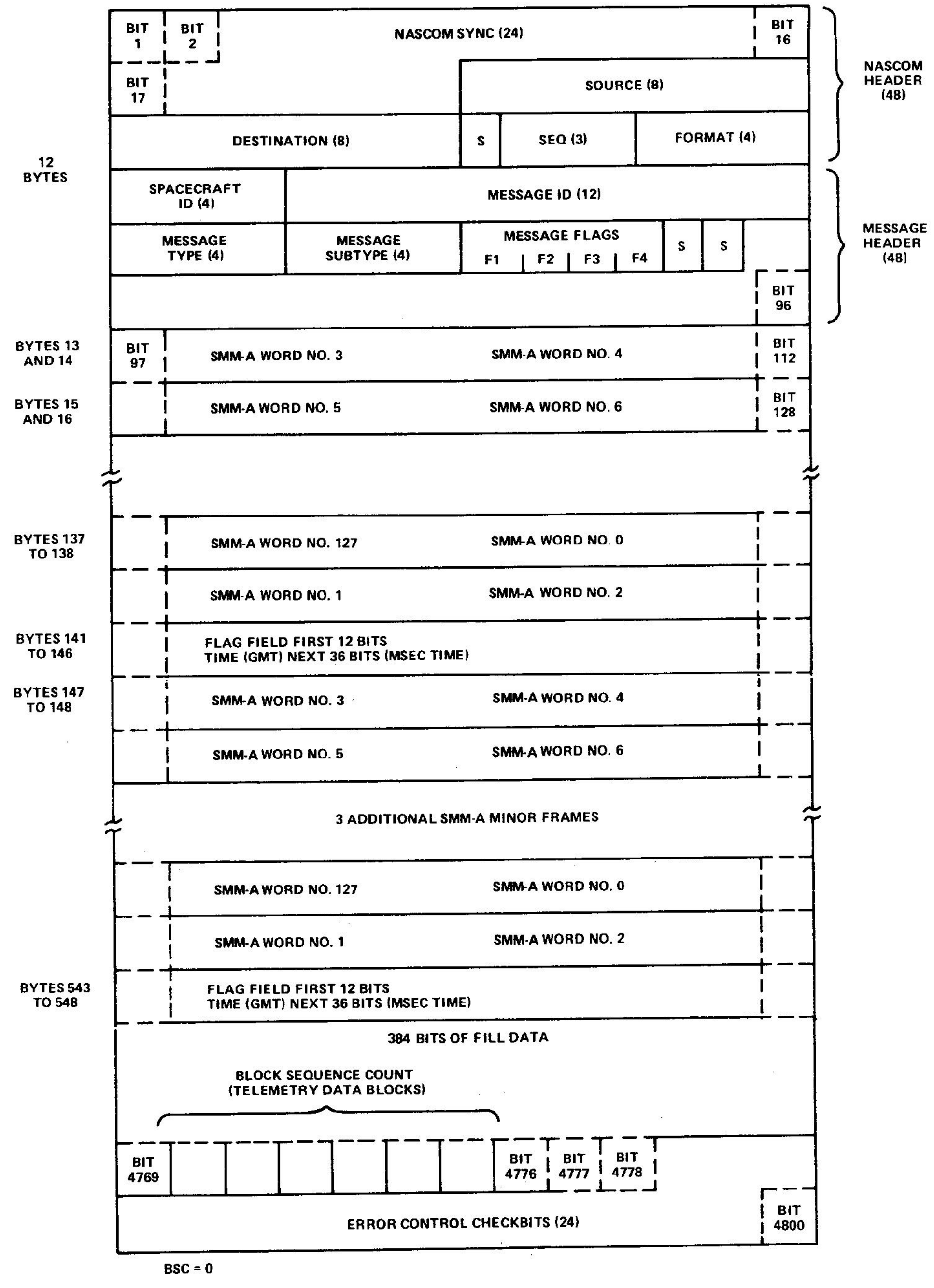


Figure 5-4. SMM-A Project Data Format A, Real-time Data 16 kbps from Observatory

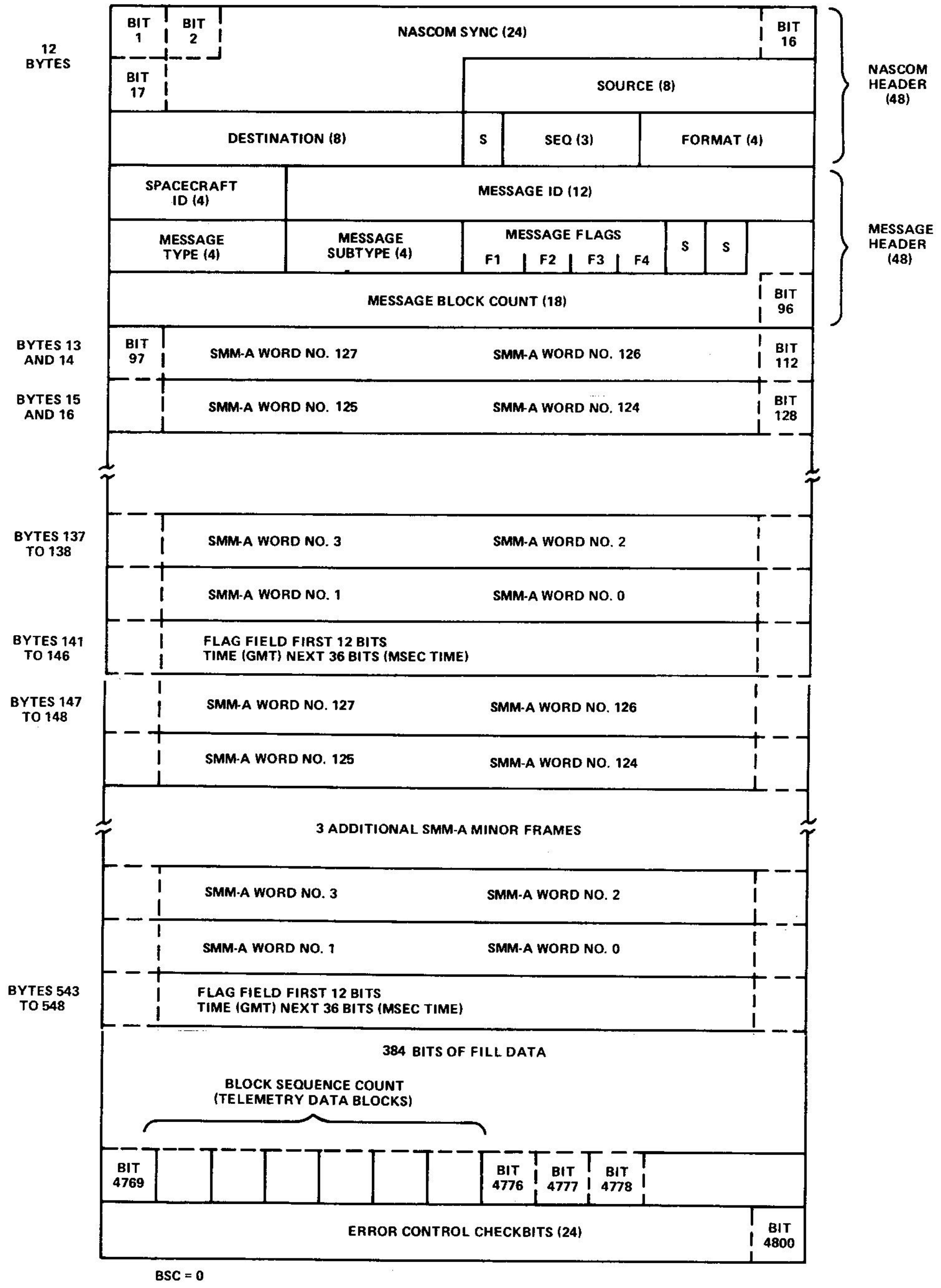


Figure 5-5. SMM-A Project Data Formats D, F, H and J. Playback Data 512 kbps from Observatory

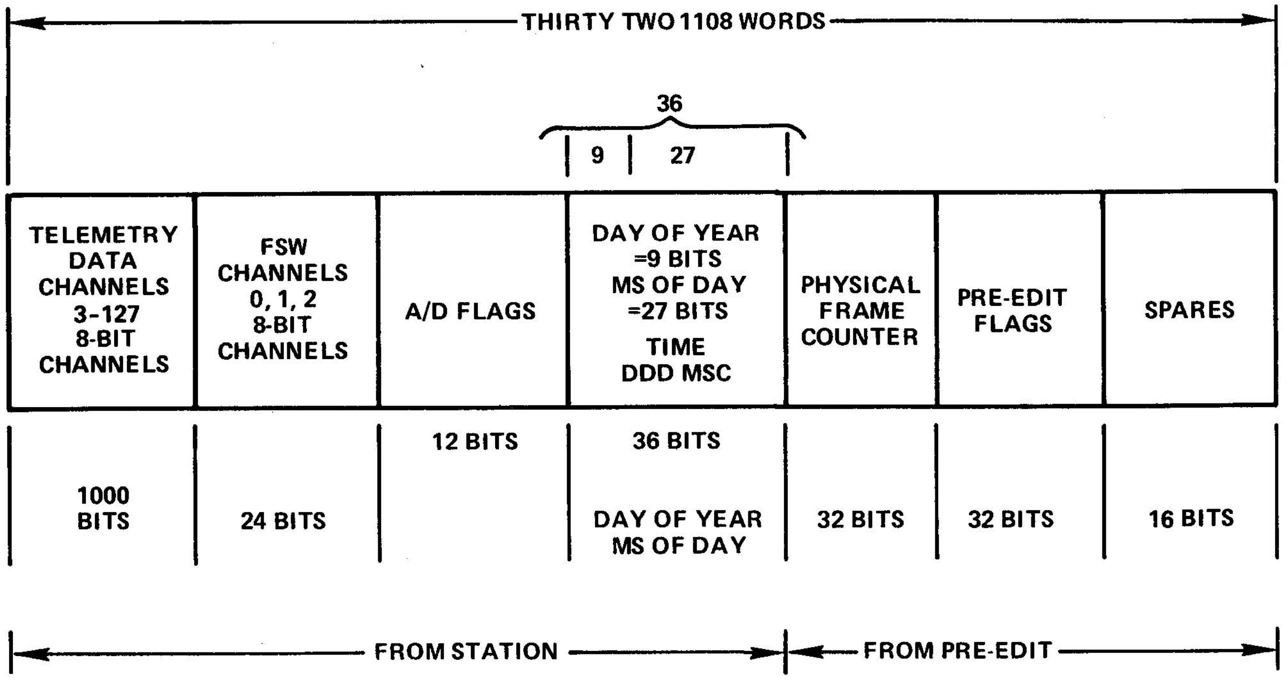
After the data messages have been completely assembled, a pre-edit program performs error detection and quality evaluation of the telemetry messages. A telemetry message is typically a real-time pass or a spacecraft tape recorder dump taken at the station. The pre-edit program will accumulate quality-related statistics on a frame and message basis. For each telemetry message the pre-edit program builds a mass storage resident file of processed telemetry frames. The pre-edit program is started by the TELOPS scheduler specifying a 16-byte message key. A message parameter setup is initially performed using the spacecraft's PDF parameter record as shown in Table 5-1. After preliminary program setup of input and output locations, the pre-edit program reads the input blocks from the 24-hour hold file. It locates and deblocks the NASCOM input blocks, locates retransmitted blocks when a gap is found in the message block count (MBC), and merges them with the other input blocks. Each telemetry frame is extracted, and frame and data word reversal is performed for the playback data. The frame sync words of the SMM-A telemetry playback data are not reversed by the TELOPS pre-edit program. The frame sync word is checked and bit errors are counted for the frame sync word when disagreement with the nominal pattern is found. Also, data and time quality analyses are performed on the UTC ground time, spacecraft clock, and frame counter. The telemetry data format is identified, and the spacecraft tape recorder unit in operation is noted if it is playback data. A pre-edit flag field is prepared for each telemetry minor frame that contains flags about signal losses, time discontinuities, and related information. The format of the pre-edit flag field is shown in Table 5-2. The pre-edit file of the message is then built by placing each minor frame into a transfer file block. The format of the minor frame is shown in Figure 5-6. The time field of each minor frame contains the station time obtained at the end of the 24-bit frame sync pattern. The frame sync pattern at the end of the minor frame belongs actually to the next minor frame. Therefore, the time field indicates the time at the end of the minor frame plus 1.5 milliseconds (three sync words). The processed data are placed into a resident file in mass storage for access by the next processing step of editing and time annotating the SMM-A telemetry data.

Table 5-1
Spacecraft PDF Parameter Record

Description	Attributes			
	Real-Time		Playback	
PDF (SMM-A)	A	C	D, F, H, J	E, G, I, K
DATA TYPE	S/C Data	HAO Data	S/C Data	HAO Data
FORWARD/REVERSE	Forward	Forward	Reverse	Reverse
BIT/FRM W/FSW	1024	1024	1024	1024
FRAMES/SEQUENCE	128	N/A	128	N/A
FRM CNTR RANGE	0-127	None	0-127	None
BITS/FRM CNTR	7	None	7	None
OFFST BYTE+BIT	64+0	N/A	64+0	N/A
FRM CNTR INCRM	1	None	1	None
MODE BIT SIZE	2	2	2	
OFFST BYTE+BIT	3+3	3+3	3+3	3+3
BITS/FSW	24	24	24	24
OFFST BYTE+BIT	125	125	125	125
FSW PATT (HEX)	FAF320	FAF320	04CF5F	04CF5F
BITS/SC CLOCK	24	None	24	None
BITS/PIECE 1	8	None	8	None
BITS/PIECE 2	16	None	16	None
BITS/PIECE 3	N/A	N/A	N/A	N/A
FRM FREQ, PC 1			-2	-2
FRM FREQ, PC 2				
FRM FREQ, PC 3				
BYT OFFST, PC 1				
BYT OFFST, PC 2				
BYT OFFST, PC 3				
CLOCK INCREM	1	None	1	None
BITS/UTC	36	36	36	36
OFFST BYTE+BIT	129+4	129+4	129+4	129+4
UTC INCREM (MS)	64	4	2	2
UTC TOL (+/-MS)	3			
SCOM2 SYNC FRM	N/A	N/A	N/A	N/A
SCOM2 SYNC PAT	N/A	N/A	N/A	N/A
BITS/SC2 SYNC	N/A	N/A	N/A	N/A
OFFST/SC2 SYNC	N/A	N/A	N/A	N/A
BITS/SCOM 3 WRD	N/A	N/A	N/A	N/A
OFFST, SC3 WORD	N/A	N/A	N/A	N/A
ENCODING RATIO	No	No	No	No
BRC (4800 NIB)	4	4	4	4

Table 5-2
Pre-edit Flags

Bit	Contents	
1	(MSB)	Decoding is suspect (not used for SMM)
2		Partial frame
3		Spare
4		Spare
5		Data gap
6		Frame counter error detected
7		Spare
8		Positive spacecraft clock error
9		Negative spacecraft clock error
10		Positive ground time error
11		Negative ground time error
12		Frame counter jump detected
13		Spare
14		Positive spacecraft clock jump
15		Negative spacecraft clock jump
16		Positive ground time jump
17		Negative ground time jump
18		Illegal ground time from station
19		Questionable data point
20		SUBCOM II error (not used for SMM)
21		SUBCOM III error (not used for SMM)
22		Verified mode change
23		Fraction start
24		Fraction end
25		Data point between fraction
26		Questionable spacecraft clock
27		Questionable ground time
28		Spare
29-32	(LSB)	Imperfect frame sync pattern (4-bit field)



A/D FLAGS

F5 = BIT SLIPPAGE
F6 = DATA INPUT TERMINATION
F7 = FSW BIT ERRORS
F8 = FLYWHEELING
F9 = AOS
F10 = LOS

SPARE
SPARE
SPARE
SPARE
P_{27} = ODD PARITY BIT FOR MS OF DAY
P_{36} = ODD PARITY BIT FOR MS OF DAY AND DAY OF YEAR

Figure 5-6. Minor-frame Format

5.2.4 Telemetry Data Editing

The telemetry data will be edited by an edit program on the UNIVAC 1108 computer. The program will edit playback data (and on request, real-time data) from the TELOPS transfer subfiles according to a matrix of telemetry major and minor frames. The edit program will provide fill data in areas where signal losses have occurred, and it will correlate and annotate the data with GMT.

The time correlation will be performed by using the spacecraft clock and the frame counter, to provide the time of actual data sampling. The program will also compute several processing flags required in later processing steps. The data will be written into edit subfiles that will be used as input to the subsequent data processing step. Data quality information and accounting information will be produced for intermediate data analysis and as a basis for releasing the data to the next processing step.

5.2.4.1 Edit Program Input Data. The input data for the edit program will be staged from the TELOPS mass storage by the UNIVAC 1108 ITCS program via a data channel that connects the IBM 370/145 with the UNIVAC 1108. A query request file containing the file keys of the desired data initiates the data transfer to a 1108 disk file, where the input data are then accessed by the 1108 edit program.

The data can be staged to the UNIVAC 1108 by means of a transfer tape as a backup support. The transfer tape is read into the disk data file by the ITCS program. The data on the disk will appear in the normal format as described below. The transfer tape will be a 9-track tape with a packing density of 6250 bpi. Figure 5-7 shows the detailed format of the transfer tape, and Figure 5-8 shows the 9-byte header format.

ITCS will stage the scheduled pre-edit data to the UNIVAC 1108 disk for access by the SMM-A UNIVAC 1108 edit program. The requested input data will be available in subfiles as shown in Figure 5-9. A specified ITCS call from the edit program will fetch the header information. The pre-edit key identifying the subfile is given in 16 EBCDIC characters as follows:

Byte		
3	'P'	For pre-edit
4-5	NN	Spacecraft ID (TELOPS assigned ID; ID = 13 for SMM-A)
6-14	YYDDDHHMM	AOS from message summary
15-17	NNN	Sequence number
18	N	Version number

A different specified ITCS call from the edit program will fetch the telemetry frames from the subfile for subsequent editing into major frames.

5.2.4.2 Edit Program Output Data. The Edit Program will produce formatted edit data and will write this information to an edit data file. Figure 5-10 shows the edit data file format, Table 5-3 shows the format of the edit label record, Table 5-4 shows the major-frame header, and Figure 5-11 shows the edit minor-frame format.

Data are typically edited for one complete data day, and a built-in data merge program will chronologically arrange all data for one edit run. Redundant data are removed during the data merging. The telemetry spacecraft format ID is examined during the merge process, and the data are separated into data files according to the telemetry format ID (refer to Table 5-5 for definition of format ID). The last major frame in a data file and the first major frame in the following data file will be redundant major frames and the minor-frame pointer points to the minor frame where the format change occurred, i.e., where the new telemetry format started.

The data are written into one or more edit output files and a summary of all edit files and their data quality is printed for later quality control (see Figure 5-12). Accounting information is also prepared for each data file for later access by the TELOPS Central Integrated Information System. Header information according to TELOPS specifications is produced for each edit file (refer to Table 5-6). The completed edit files are then destaged as subfiles by TELOPS for insertion into the TELOPS mass storage. The next processing step will fetch the data from the mass storage for the final processing step of decommutation.

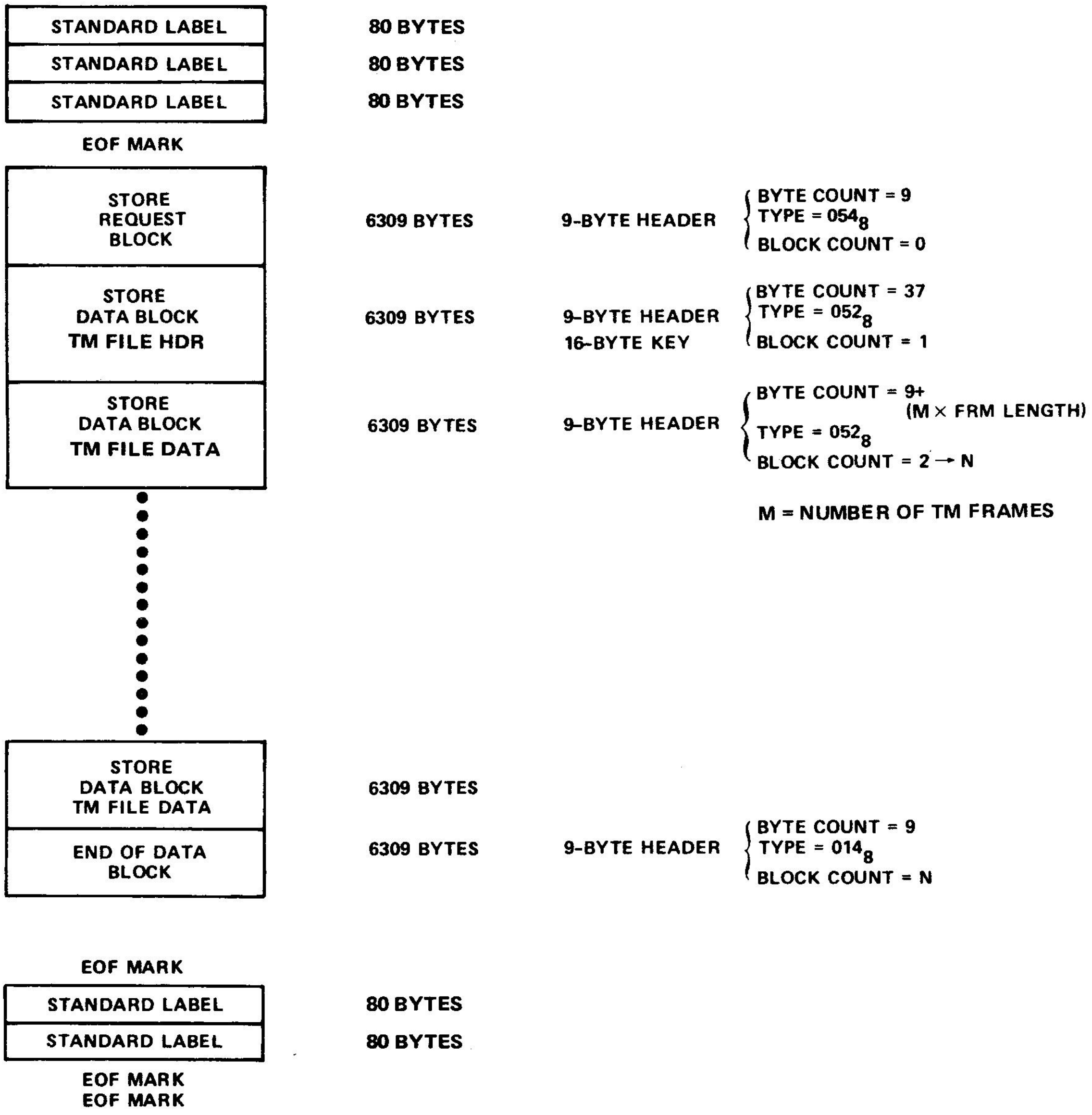


Figure 5-7. Pre-edit Transfer Tape Format

01 2 BYTES BYTE COUNT 16	SOURCE 17	BLOCK TYPE 18 1 BYTE 24	25 NOT USED 1 BYTE 32
33 CONSECUTIVE BLOCK COUNT 2 BYTES 48	49 NOT USED 1 BYTE 56		57 NOT USED 1 BYTE 64
65 FLAGS - 1 BYTE 72			

BYTE COUNT	BYTE COUNT OF ACTUAL DATA IN 6309-BYTE RECORD (INCLUDES 9-BYTE HEADER)
SOURCE	0 = IBM 370 1 = UNIVAC 1108
BLOCK TYPE	0101100 = STORE REQUEST BLOCK 0101010 = STORE DATA 0001100 = END OF DATA
CONSECUTIVE BLOCK COUNT	0 = STORE REQUEST BLOCK 1 = STORE DATA TM FILE HDR 2-N = STORE DATA TM FILE DATA N = END OF DATA (SAME AS PRECEDING STORE DATA BLOCK)
FLAGS	BIT 65 = 1 IF MORE DATA TO FOLLOW = 0 IF END OF DATA

Figure 5-8. Nine-byte Header Format

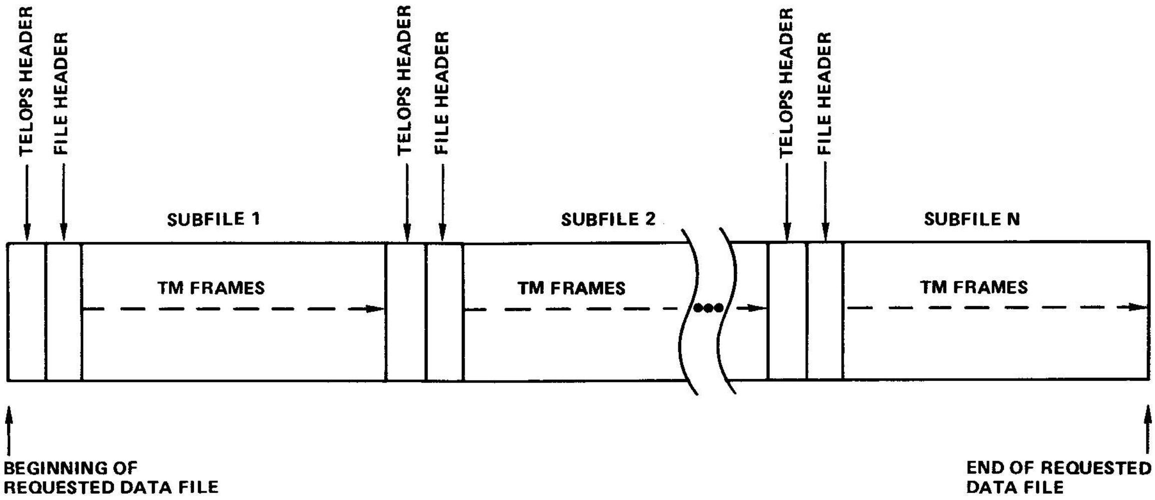
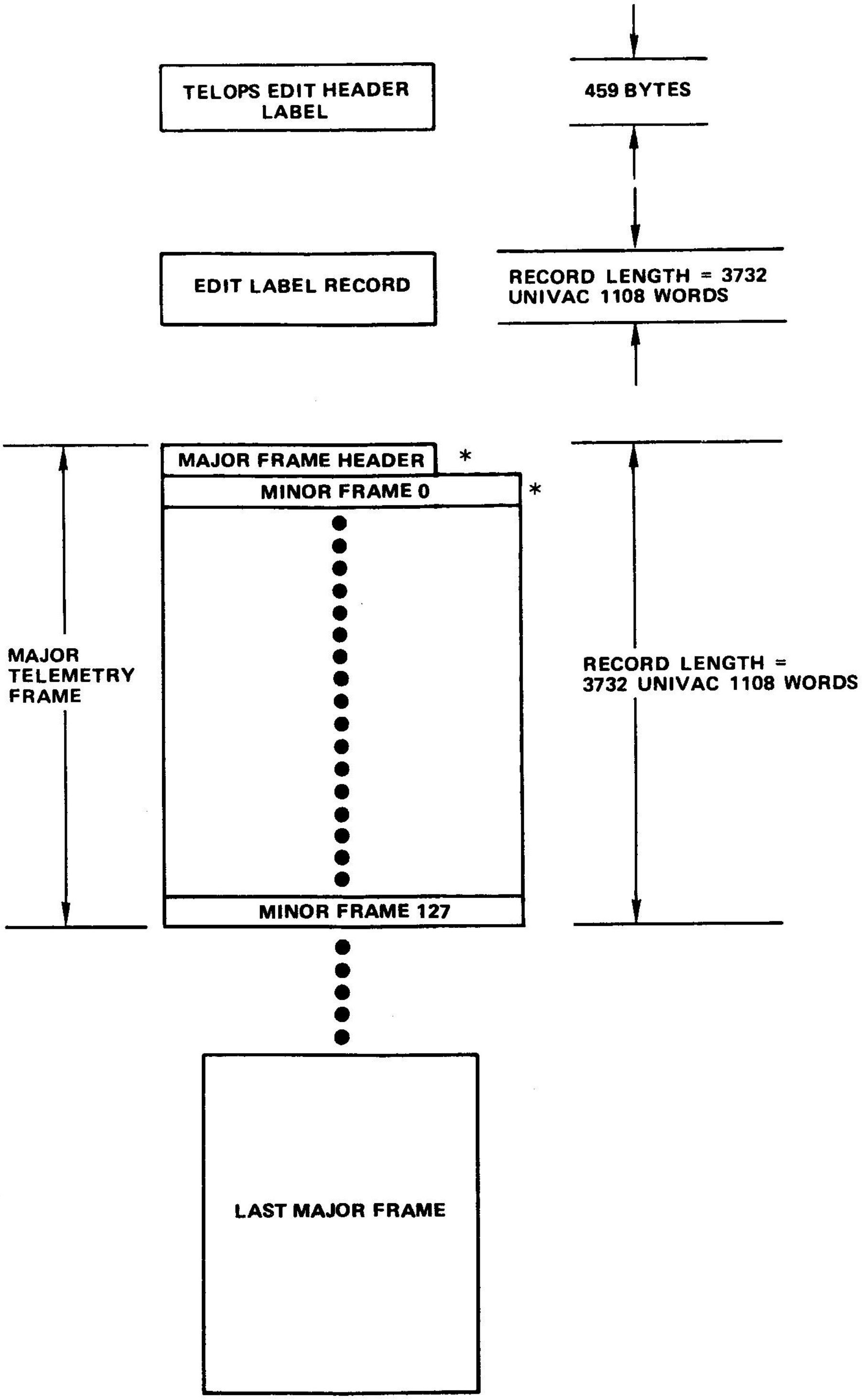


Figure 5-9. Example of ITCS Input File



*NOTE: THE MAJOR FRAME HEADER IS 20 WORDS LONG, A MINOR FRAME IS 29 WORDS LONG

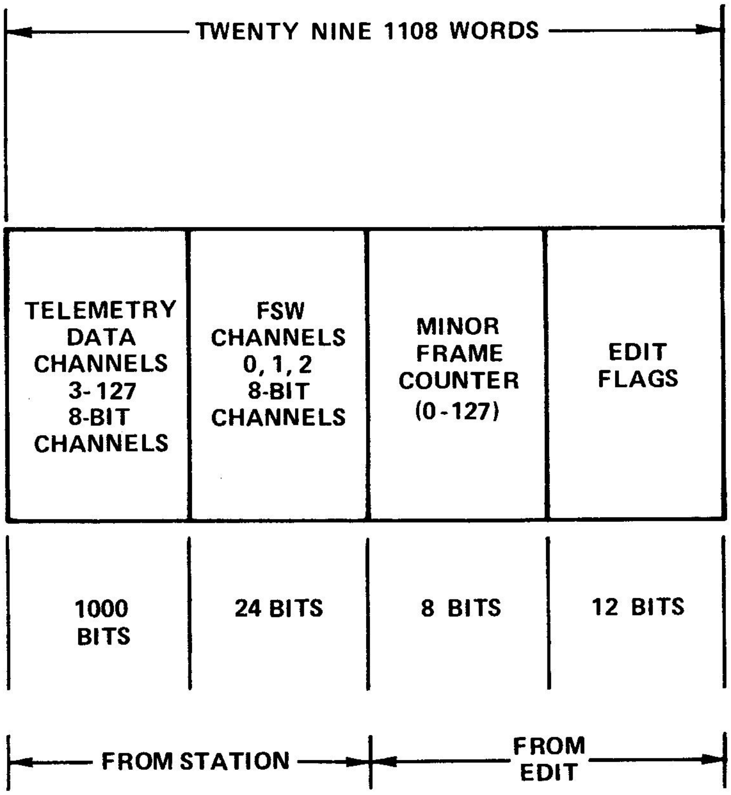
Figure 5-10. Edit Data File Format

Table 5-3
Edit Label Record Description

Word	Type	Contents
1	Integer (I)	=1
2	I	Year of data
3	I	Start day count of data (1-366)
4	I	Start time of data (milliseconds of day)
5	I	Stop day count of data (1-366)
6	I	Stop time of data (milliseconds of day)
7	I	Format ID 0 = Science Format 1 = Engineering Format 2 = OBC Flexible Format 3 = Dwell Mode/Science Format 4 = Dwell Mode/Engineering Format 5 = Dwell Mode/OBC Flexible Format
8	I	Data file break condition 0= Inclusive file 1 = Introductory file 2 = Intermediate file 3 = Final file
9	I	S/C clock at file start time
10	I	S/C clock at file end time
11-13	FD	TELOPS N-Key
14-16	FD	TELOPS P-Key
17	I	Number of major frames in file
18	I	Number of minor frames with bit errors in frame sync word
19	I	Number of minor frames with fill data
20	FD	Satellite ID = 'SMM1'
21	FD	Source Station Code (three char)
22	FD	PDF (one char)
23	I	Dwell mode word
24	I	Bit Rate 0 = 1 kbps 1 = 2 kbps 2 = 4 kbps 3 = 8 kbps 4 = 16 kbps 5 = 32 kbps 6 = 64 kbps
25	I	HAO ID Info.
26-28		Spare
29	I	Start time milliseconds of year (biased)
30	I	Stop time milliseconds of year (biased)
31-246	EBCDIC	Pre-edit IIS Header
247-3732		Spares

Table 5-4
Major-frame Header

36-bit Word	Form	Contents
1	Integer (I)	Type of data = 3 for telemetry data
2	I	Block count (1-N)
3	I	Spacecraft clock + 4 bits (LSB); Resolution is 64 msec for LSB
4	I	Day of year
5	I	Milliseconds of day
6	I	Milliseconds of year
7	I	Number of fill frames
8	I	Number of frames with synch errors
9	I	Number of frames with station A/D flag
10	I	Intermediate edit file number
11	I	Ground GMT in milliseconds of year
12	I	Minor frame pointer to mode transition
13-19		Spares
20	I	Checksum of data words 21-3732


TWENTY NINE 1108 WORDS
TELEMETRY DATA CHANNELS 3-127 8-BIT CHANNELS
FSW CHANNELS 0, 1, 2 8-BIT CHANNELS
MINOR FRAME COUNTER (0-127)
EDIT FLAGS
1000 BITS
24 BITS
8 BITS
12 BITS
FROM STATION
FROM EDIT

EDIT FLAGS

BIT (BIT 1 = MSB)	
1	SPARE
2	SPARE
3	SPARE
4	SPARE
5	SPARE
6	SPARE
7	SPARE
8	INVALID MSEC OF DAY IN GROUND TIME
9	INVALID DAY OF YEAR IN GROUND TIME
10	INVALID FRAME TIME INCREMENT
11	0 = GOOD FRAME SYNCH; 1 = DEFECTIVE FRAME SYNCH
12	0 = DATA; 1 = FILL (ZERO FILL IN ENTIRE FRAME)

Figure 5-11. Minor-frame Format of Edit File

Table 5-5
Format ID Definition

Set Format ID to this number	Word 3 Bits 4-5	Word 67 Bit 1
0 = Science Format	10	0
1 = Engineering Format	01	0
2 = OBC Flexible Format	11	0
3 = Dwell Mode, in Science Format	10	1
4 = Dwell Mode in Engineering Format	01	1
5 = Dwell Mode in OBC Flexible Format	11	1

Notes:

1. Word 3 and word 67 are **fixed minor frame** words in the SMM telemetry format.
2. Bit 1 is the most significant bit in the telemetry word.

```
HA02 FDT 9016                                                                                   DATE  021679     PAGE       48

                                        QUALITY LISTING FOR EACH PRE-EDIT INPUT FILE
   PRE-EDIT KEY    RAW TIME              TOTAL   PCT.    PCT.    NO.      NO. OF
   AOS                  (SEC.OF         DAY) # OF    FULL    0        OF ENG. FULL PERFECT
   TIME             START STOP           FULL    MIN.    ERROR   FRAMES   MJ FR.            BAD TIMES      % GOOD MAJOR FRAMES
PIDYYDDDHHMMSEQV SSSSS SSSSS             MIN.FR  FR.REC.

P077901800460010  2974  2793             11310   9999    9998       0      84 U                 0              96.55
P077901802270010  9148  8844             18964   9990    9998       0     139 U                 0              94.56
P077901804530010 18031 17593             27392   9998    9998       0     210 U                 0              98.59
P077901806320010 23859 23560             18716  10000    9998       0     145 U                 0             100.00
P077901807190010 26520 26379              8812   9997    9996       0      66 U                 0              97.06
P077901809000010 32705 32403             18892   9996    9997       0     146 U                 0             100.00
P077901814450010 53642 53142             31252   9999    9999       0     242 U                 0              99.59
P077901816260010 59749 59212             33518   9983    9997       1     253 U                 0              96.93
P077901818060020 65660 65207             28308   9968    9997       0     217 U                 0              98.64
P077901820100010 73141 72626             32159   9978    9997       1     247 U                 0              98.41
P077901821090010 76345 76168             11108   9997    9997       0      83 U                 0              96.51
P077901821530010 78926 78794              8250  10000    9996       0      63 U                 0              98.44
P077901822400020 81768 81201              8926   2517    9431     496      64 U                 1              96.57
P077901900320010  2263  1927             20982   9994    9998       0     156 U                 0              96.30
```

Figure 5-12. Edit File Summary (Part 1 of 2)

```
      HAJ2 EDT 9018                                                                                     DATE  021679     PAGE        45

                                                   EDT FILE SUMMARY

START TIME   STOP TIME   PRE-EDIT KEY                  EDIT KEY
DAY HH MM SS HH MM SS   PIDYYDDDHHMMSEQV STA F   FIDYYDDDHHMMSEQV  XFRD   INT TP FL  #FRMS   FL  FR.ER.  ENG.FR  T F  %RECOV.  %GOOD FR.
 18  0 45 43  1 12 20   PC77901802270010 HAW G   EC77901800010012 @@@@@@           1    40    2     47        0 003 100.000   99.082
 18  1 12 20  1 17  7   PC77901802270010 HAW G   EC77901800010022 @@@@@@           2     7    3      0        0 007 100.000  100.000
 18  1 17  7  2 26  4   PC77901802270010 HAW G   EC77901800010032 @@@@@@           3   101    4     12        0 103 100.000   99.907
 18  2 26  4  3 32 17   PC77901804530010 ACN G   EC77901800010042 @@@@@@           4    97    5     10        0 003 100.000   99.919
 18  3 32 17  3 37  4   PC77901804530010 ACN G   EC77901800010052 @@@@@@           5     7    6      0        0 007 100.000  100.000
 18  3 37  4  4 52 10   PC77901804530010 ACN G   EC77901800010062 @@@@@@           6   110    7      2        0 003 100.000   99.986
 18  4 52 10  5 57 42   PC77901806320010 ACN G   EC77901800010072 @@@@@@           7    97   -8     89        0 003 101.042   99.283
 18  5 57 42  6  2 28   PC77901806320010 ACN G   EC77901800010082 @@@@@@           8     7    9      0        0 007 100.000  100.000
 18  6  2 28  6 31  9   PC77901806320010 ACN G   EC77901800010092 @@@@@@           9    42   10      0        0 003 100.000  100.000
 18  6 31  9  7 18 15   PC77901807190010 GWM G   EC77901800010102 @@@@@@          10    69   11     94        0 003 100.000   98.936
 18  7 18 15  7 42 50   PC77901809000010 GWM G   EC77901800010112 @@@@@@          11    36   12      7        0 003 100.000   99.848
 18  7 42 50  7 53  4   PC77901809000010 GWM G   EC77901800010122 @@@@@@          12    15   13      0        0 007 100.000  100.000
 18  7 53  4  8 58 36   PC77901809000010 GWM G   EC77901800010132 @@@@@@          13    96   14      0        0 003 100.000  100.000
 18  8 58 36  9 46 23   PC77901820100010 ACN G   EC77901800010142 @@@@@@          14    70   15     43        0 003 100.000   99.520
 18  9 47 45 10 28 43   PC77901816260010 MIL G   EC77901800010152 @@@@@@          15    61   16     65        1 003 100.000   99.168
 18 10 28 43 10 33 30   PC77901816260010 MIL G   EC77901800010162 @@@@@@          16     7   17      4        1 007 100.000   99.554
 18 10 33 30 11 19 14   PC77901816260010 MIL G   EC77901800010172 @@@@@@          17    67   18      5        1 003 100.000   99.942
 18 11 21 17 11 56 47   PC77901818060020 MIL G   EC77901800010162 @@@@@@          18    53   19     16        0 003 100.000   99.764
 18 11 58 50 13  7  6   PC77901814450010 MIL G   EC77901800010192 @@@@@@          19   101   20      4        0 003 100.000   99.969
 18 13  7  6 13 18 42   PC77901814450010 MIL G   EC77901800010202 @@@@@@          20    17   21      0        0 007 100.000  100.000
 18 13 18 42 14 44 43   PC77901814450010 MIL G   EC77901800010212 @@@@@@          21   126   22      0        0 003 100.000  100.000
 18 14 44 43 15 43 25   PC77901816260010 MIL G   EC77901800010222 @@@@@@          22    86   23      3        0 003 100.000   99.973
 18 15 43 25 15 48 12   PC77901816260010 MIL G   EC77901800010232 @@@@@@          23     7   24      0        0 007 100.000  100.000
 18 15 48 12 16 11 25   PC77901816260010 MIL G   EC77901800010242 @@@@@@          24    34   25      0        0 003 100.000  100.000
 18 16 11 25 17 19  0   PC77901818060020 MIL G   EC77901800010252 @@@@@@          25    99   26     36        0 003 100.000   99.716
 18 17 19  0 17 31 58   PC77901818060020 MIL G   EC77901800010262 @@@@@@          26    19   27      0        0 007 100.000  100.000
 18 17 31 58 18  5 25   PC77901818060020 MIL G   EC77901800010272 @@@@@@          27    49   28      0        0 003 100.000  100.000
 18 18  5 25 19 25 58   PC77901820100010 ACN G   EC77901800010282 @@@@@@          28   118   29     85        1 003 100.000   99.437
 18 19 25 56 19 38 16   PC77901820100010 ACN G   EC77901800010292 @@@@@@          29    18   30      0        1 007 100.000  100.000
 18 19 38 16 20  8 59   PC77901820100010 ACN G   EC77901800010302 @@@@@@          30    45   31      0        1 003 100.000  100.000
 18 20  8 59 21  8 22   PC77901821090010 HAW G   EC77901800010312 @@@@@@          31    87   32     41        0 003 100.000   99.632
 18 21  8 22 21 52  4   PC77901821530010 ACN G   EC77901800010322 @@@@@@          32    65  -33    104        0 003 101.563   98.750
 18 21 52  4 22 39 10   PC77901822400020 GWM G   EC77901800010332 @@@@@@          33    67  -34    222      496 003  97.101   97.411
 18 22 41 13 22 45 19   PC77901900320010 HAW G   EC77901800010342 @@@@@@          34     7   36      2        0 007 100.000   99.777
 18 22 45 19 23 49 29   PC77901900320010 HAW G   EC77901800010352 @@@@@@          35    94   37     12        0 003 100.000   99.900
 18 23 49 29 23 53 35   PC77901900320010 HAW G   EC77901800010362 @@@@@@          36     6   38      0        0 007 100.000  100.000
 18 23 53 35 23 58 21   PC77901900320010 HAW G   EC77901800010372 @@@@@@          37     7   39      0        0 005 100.000  100.000
 18 23 58 21  0 30 27   PC77901900320010 HAW G   EC77901800010382 @@@@@@          38    47   40      2        0 001 100.000   99.967
```

Figure 5-12 (continued). Edit File Summary (Quality Listing for Each Pre-edit Input)

Table 5-6
Edit Header Label for IIS

Item	Field Name	Length	Displacement	Type	Description	Source	Notes for SMM-A
1	ENIPS	XL002	0	-	Used by NIPS	NIP ---	
2	EKEY	CL016		A	Record key	ITP ---	
2A	ETYP	CL001	2	A	File type	ITP ---	'E'
2B	ESAT	CL002	3	A	Satellite ID	ITP ---	=13 for SMM-A
2C	EUTC	CL009	5	A	Corrected event time	ITP ---	YYDDDHHMM
2D	ESEQ	CL003	14	A	Sequence number	ITP ---	Edit subfile No.
2E	EVER	CL001	17	A	Version number	ITP ---	Version: 0 → 9, A → Z
3	ESEG	XL001	18	N	Segment	ITP ---	= 0
4	ENIPS2	XL005	19	-		NIP ---	
5	EVSZ	XL004	24	-		NIP ---	
6	EUSER	OF (zero)		-		--- ---	
7	EDAY	XL004	28	N	Day number (RECDIO use)	--- REC	
8	ETOD	XL004	32	N	Time of day (RECDIO use)	--- REC	
9	EFILSZ	XL004	36	N	Edit file size in bytes	ITP ---	No. of bytes incl. IIS header
10	ENUMFRM	XL004	40	N	Num frames edit file	ITP ---	No. of major frames in file
11	EIDBPTR	XL004	44	N	IDB PTR for P/E	--- REC	
12	EIDBNUM	XL004	48	N	Num of P/E IDBS	ITP ---	=1
13	EDIDBPT	XL004	52	N	IDB PTR for decom	--- REC	
14	EDIDBNM	XL004	56	N	Num decom IDBS	--- REC	
15	EAUXNAM	CL022	60	A	Aux file name	ITP ---	Pre-edit key and station and PDF
16	EEDTRUN	CL009	82	A	ITP run date	ITP ---	bbbMMDDYY
17	EITPRUN	CL008	91	A	ITP run num	ITP ---	bbbbYDDD
18	ERUNTYP	CL004	99	A	ITP run type	ITP ---	PROD or QLbb
19	EGORBIT	CL012	103	A	Group/orbit num	--- OFU	Quality indicator
20	EQCODE	CL003	115	A	Quality	ITP ---	Expt. format ID
21	EFILBGN	CL014	118	A	Edit file start time	ITP ---	YYDDD:HH:MM:SS
22	EFILSTP	CL014	132	A	Edit file stop time	ITP ---	YYDDD:HH:MM:SS
23	EFILSPN	CL012	146	A	Time span	ITP ---	N/A
24	ECORFIL	CL080	158	A	5 corr files	--- OFU	
25	ESPARE1	CL007	236	A		--- ---	
26	EEDTAPE	CL016	245	A	Edit tap	ITP ---	N/A
27	EMSEDIT	CL016	261	A	Master edit	ITP ---	N/A
28	EMSTIME	CL016	277	A	Time history	ITP ---	N/A
29	EMSDATA	CL016	293	A	Master data	ITP ---	N/A
30	EPRENUM	CL002	309	A	Num preedits	ITP ---	b1
31	EPNUSED	CL002	311	A	Num PE used	ITP ---	b1
32	EREDID	CL001	313	A	Edit was redone	--- OFU	
33	EMSGID	CL016	314	A	Key on current file	ITP ---	N/A
34	EORBKEY	CL016	330	A	Orbit file key	--- OFU	
35	EORBFIL	CL008	346	A	ITP ORB file ID	ITP ---	N/A
36	EEDECOM	CL009	354	A	Decom processed time	IP ---	
37	ESATID	CL004	363	A	Sat ID	ITP ---	'SMM1'
38	EARRIVE	CL009	367	A	Time of arrival at MSF	IP ---	
39	EMSFVOL	CL006	376	A	MSG vol ID	IP ---	
40	EARCHIV	CL004	382	A	Archive Locn	--- OFU	
41	EINTAPE	CL007	386	A	Input edit tape ID	IP ---	
42	EXFVOL	CL007	393	A	Edit transfer tape	MOV ---	
43	EBUVOL	CL007	400	A	Edit backup volume	MOV ---	
44	EARVOL	CL007	407	A	Edit archive volume	MOV ---	
45	EMSGID	CL016	414	A	Message ID	ITP ---	N-Key of TELOPS
46	EPEID	CL016	430	A	Preedit ID	ITP ---	Pre-edit key
47	EPEQUAN	CL007	446	A	No. of frames used in edit	ITP ---	
48	ESCREC	CL001	453	A	S/C record	ITP ---	N/A
49	EDELCOD	CL002	454	A	Delete code	ITP ---	N/A
50	ESTATN	CL003	456	A	Station	ITP ---	AAA

Note: Length of edit header label = 459 bytes

p. 5-24 Item 15. additional note: P13YYDDDHHMMSSSVƀSSSƀX
Item 20. additional note: ƀXƀ

5.2.5 Experimenter Data Tapes

The experimenter data tapes will be prepared by the UNIVAC 1108 decommutation program. The edit data files will be used as input to the decommutation program. The following paragraphs describe the file of data that is produced on the decom tapes.

The input edit file is comprised of contiguous major frames beginning at the major-frame boundary preceding a TM format transition and continuing to the major-frame boundary immediately after the following TM format transition. (A TM format transition is defined as a change in telemetry format, or a spacecraft recorder dump boundary.) The input edit file is decommutated to produce data files for the SMM experimenters according to specified formats.

Each SMM-A experimenter data tape will contain as many complete groups of data files as can be accommodated on a single data tape formatted as shown in Figure 5-13.

p. 5-25 fig 5-13. The leftmost block should state "Data Set Label Record".

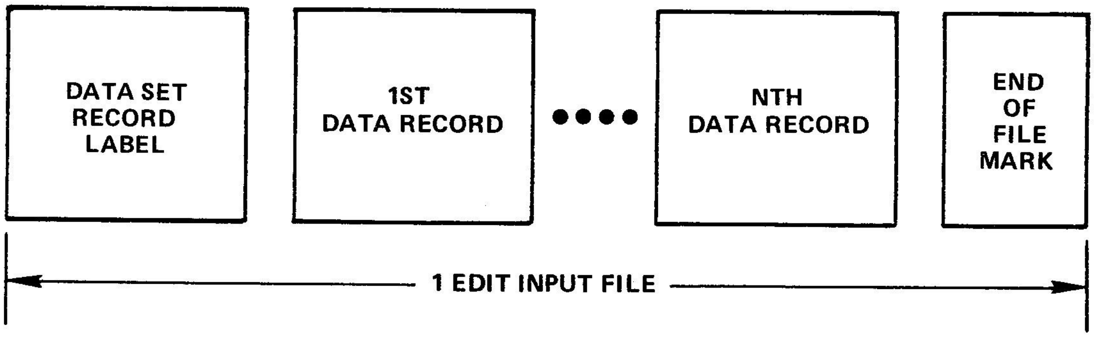


Figure 5-13. Format of SMM-A Experimenter Data Tape

Each file of data is started with the data set label record (see Table 5-7) and is followed by data records containing the decommutated data. Within each file the data from consecutive major frames are presented in consecutive groups of records. The number of records required for a single major frame depends upon each experimenter's data format and the type of data. The data type is specified within each record.

Several data fields are unique in the experimenter data records. The time field contains day count from 1979.0 epoch and milliseconds of day. The data flag field "F-map" contains the number of bit errors in the minor-frame sync word

Table 5-7
Data Set Label Record Description

Byte	Description
1	File number
2	Data type (0 = Label)
3-4	Record No. in file (0 = label record)
5-8	Year of data (year - 1900)
9-12	Start day count of data (1-366)
13-16	Start time of data (milliseconds of day)
17-20	Stop day count of data (1-366)
21-24	Stop time of data (milliseconds of day)
25-28	STDN station
29-44	Station message ID (TELOPS Pre-Edit key)
45-60	Master file name (TELOPS edit key)
61-62	Decom No.
63-64	Decom reel No.
65-68	No. of major frames in file
69-72	No. of minor frames with bit errors in frame sync word
73-76	No. of minor frames with fill data
77-78	Format ID 0 = science format 1 - engineering format 2 = OBC flexible format 3 = full dwell mode format (i.e., all minor frame words are in the following file)
79-80	Number of dwell word if in dwell mode
81-84	Start clock for file
85-88	Stop clock for file
89-90	Bit rate 0 = 1Kbps 1 = 2Kbps 2 = 4Kbps 3 = 8Kbps 4 = 16Kbps 5 = 32Kbps 6 = 64Kbps

Table 5-7 (continued)

Byte	Description		
91	File's position within the tape 0 = inclusive file 1 = introductory file 2 = intermediate file 3 = final file 4 = continued file on this tape (First portion of this file is on another tape. For HAO video data tapes only)		
92	HAO data type, record format identifier for this file 1 = type 1 2 = type 2 3 = type 3 4 = type 4 5 = type 5 6 = type 6 7 = type 7 8 = type 8		
93-98	Decom run date		
99-101	Spares		
For Decom Internal Use Only			
102	X-1A-W	reel #	(0 = not done)
	X-1B	reel #	
103	X-1C-W	reel #	
	X-2-W	reel #	
104	X-3-W	reel #	
	X-4A-W	reel #	
105	X-4B-W	reel #	
	X-4C-W	reel #	
106	X-4D-W	reel #	
	X-5A-W	reel #	
107	X-5B-W	reel #	
	X-5C-W	reel #	
108	X-6-W	reel #	
	X-7-W	reel #	

p. 5-27 byte 102 (LSB) should be "X-1B-W".

the fill data flag. The term "F-map" is defined as a 4-bit integer that gives a data quality assessment for each minor frame where:

1111 = all data for minor frame are fill data

●
● = numbers between indicate number of sync errors
●

0000 = all data for minor frame are good data

The data flag field "M-flag" contains flag information about each entire major frame. The term "M-flag" is defined for a major frame as follows:

00000000 = some fill data in major frame

00001111 = no fill data, but some sync errors

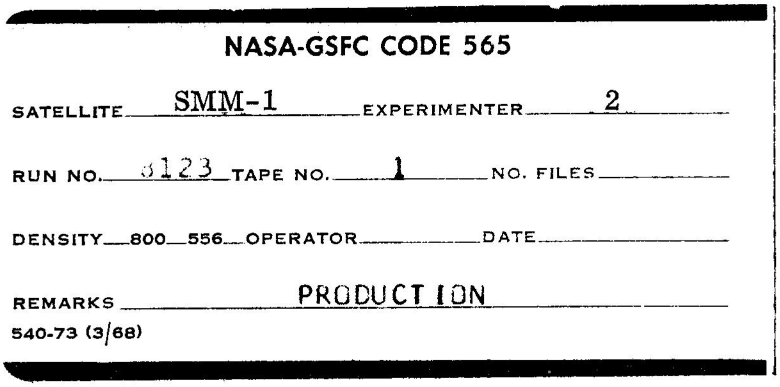
11111111 = no fill data, no sync errors

The minor-frame pointer field contains the minor-frame number (0-127) where the TM format transition occurred. This field is valid only for the first and last major frame in a file. A special case of occurrence is a complete last major frame where the mode transition occurred in minor-frame 0 of the next major frame. This case is identified by the insertion of 0 into the minor-frame pointer field.

The experimenter data tapes will be typically produced by a decom run for one complete data day. Each reel of tape mailed to the experimenter is externally labeled with the following information: spacecraft name (SMM-1), experimenter number, decommutation run number, and experimenter's tape-sequence number in the decom run. The computer operator is instructed by the decom program to attach the external tape label (see Figure 5-14) to the data tape assigned to the experimenter.

The decom program produces shipping letter listings for use by Quality Control before the data tapes are shipped to the experimenter. The label record contents for each file are listed, as well as accounting information. (Refer to Table 5-8 for the TELOPS decom IIS header.) The listings are used by Quality Control to ensure that decommutated files are chronologically ordered.

After the data tapes have been quality checked by the tape check program (see Figure 5-15 for sample output), the data tapes are released by Quality Control for shipment to each experimenter. The shipping letter (see Figure 5-16) accompanies each shipment of decommutated tapes to the experimenter and identifies



NASA-GSFC CODE 565

SATELLITE SMM-1 EXPERIMENTER 2

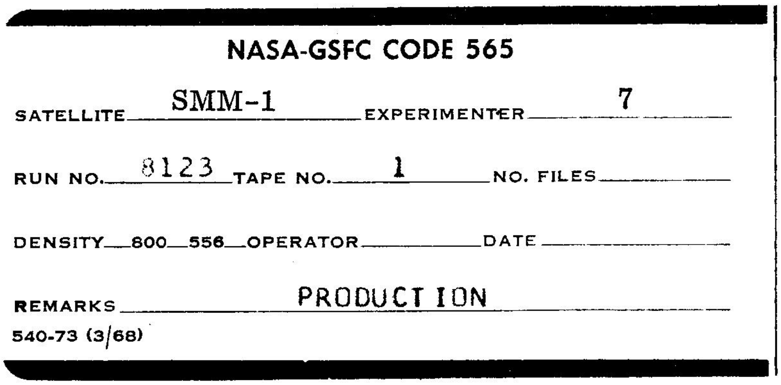
RUN NO. 8123 TAPE NO. 1 NO. FILES

DENSITY 800 556 OPERATOR DATE

REMARKS PRODUCTION

540-73 (3/68)

a. Experimenter No. 2 Data Tape Label



NASA-GSFC CODE 565

SATELLITE SMM-1 EXPERIMENTER 7

RUN NO. 8123 TAPE NO. 1 NO. FILES

DENSITY 800 556 OPERATOR DATE

REMARKS PRODUCTION

540-73 (3/68)

b. Experimenter No. 7 Data Tape Label

Figure 5-14. Sample External Labels

Table 5-8
TELOPS Decom IIS Header

Item	Field Name	Length	Displacement	Type	Description	Source	Notes for SMM-A
1	DNIPS	XL002		-	Used by NIPS	NIP ---	
2	DKEY	CL016		A	Record key	ITP ---	
						--- ---	
2A	DTYP	CL001	2	A	File type	ITP ---	'D'
2B	DSAT	CL002	3	A	Satellite ID	ITP ---	= 13 for SMM-A
2C	DUTC	CL009	5	A	Corrected event time	ITP ---	Same as edit key YYDDDHHMM
2D	DSEQ	CL003	14	A	Sequence number	ITP ---	Edit subfile no.
2E	DVER	CL001	17	A	Version number	ITP ---	0 to 9, A to Z
3	DSEG	XL001	18	N	Segment ID	ITP ---	= 0
4	DNIPS2	XL005	19	-		NIP ---	
5	DVSZ	XL004	24	-		NIP ---	
6	DUSER	OF (zero)	-			--- ---	
7	DDAY	XL004	28	N	Day number (RECDIO use)	--- REC	
8	DTOD	XL004	32	N	Time of day (RECDIO use)	--- REC	
9	DEIDBPT	XL004	36	N	IDB PTR to edit	--- REC	
10	DEIDBNM	XL004	40	N	Num edit IDBS	ITP ---	Always 1
11	DXIDBPT	XL004	44	N	IDB PTR to experimenters	--- REC	
12	DXIDBNM	XL004	48	N	Num experimenter IDBS	ITP ---	No. of experimenter and format combinations on output
13	DAUXNAM	CL022	52	A	Aux file name	ITP ---	Same as aux. file name in edit file
14	DDECRUN	CL009	74	A	Decom run date	ITP ---	bbbMMDDYY
15	DITPRUN	CL008	83	A	ITP run number	ITP ---	bbbbYDDD
16	DRUNTYP	CL004	91	A	ITP run type	ITP ---	'PROD'
17	DSHGRUP	CL016	95	A	Ship group	ITP ---	N/A
18	DFILBGN	CL014	111	A	Decom file start	ITP ---	YYDDD:HH:MM:SS
19	DFILSTP	CL014	125	A	Decom file stop	ITP ---	YYDDD:HH:MM:SS
20	DRELDTE	CL009	139	A	Release date	--- OFU	
21	DSATID	CL004	148	A	Sat. ID	ITP ---	'SMM1'
22	DVALI	CL009	152	A	Data validation date	--- OFU	
23	DORBIT	CL006	161	A	Related orbit num	--- OFU	N/A
24	DORBFIL	CL016	167	A	Orb file key	--- OFU	N/A
25	DFILCRE	CL009	183	A	IP receipt time	IP ---	
26	DSPARE1	CL006	192	A		--- ---	
						--- ---	
27	DXPID	CL004	198	A	Experimenter ID	ITP ---	X-1 through X-7
28	DXTPINV	CL007	202	A	Tape inventory No.	--- OFU	
29	DXTPDCM	CL007	209	A	Decom tape ID	ITP ---	YDDDTN (Where N = reel no.)
30	DXFILID	CL002	216	A	File ID	ITP ---	File no.
31	DXSHPDT	CL005	218	A	Ship date	--- OFU	
32	DXACKDT	CL005	223	A	Ack date	--- OFU	
33	DXRETDT	CL005	228	A	Ret date	--- OFU	
34	DXEXPST	CL003	233	A	Exp status	--- OFU	
35	DXSPARE	CL007	236	A	Format I/D	ITP ---	'bbbFbbb' Where F = format No. 0 through 5
						--- ---	
36	DEDTKEY	CL016	198 + 45 J	A	Edit key	ITP ---	
37	DESPARE	CL002	214 + 45 J	A	Spare	--- ---	

Notes: J = DXIDBNM (Item 12)

Items 27 to 35 are repeated J times resulting in a decom IIS header length of 261, 306, ..., up to 846 bytes depending on the value of DXIBNM.

```
     HA01 DEC 7336                                                                              DATE  123177    PAGE      13

                                             HEAO-A EXPERIMENTER NO. 1 TAPE CHECK

FILE        START TIME     STOP TIME      NO.   ORB   TLM   STA   REEL   REEL   BAD    BAD   NO.    FILL    SEQ    READ
NO.  YEAR   DDD:HH:MM:SS   DDD:HH:MM:SS   REC   REC   REC   ID    NO.    FILE   TIME   CLK   GAPS   FRAMES  ERROR  ERRS

  1  1977   336:02:00:01   336:02:49:51   225     2   222   ACN     1      1      0      2     1       22      22     0
  2  1977   336:02:50:32   336:04:29:31   443     4   438   ACN     1      2      0      1     1       97      96     0
  3  1977   336:04:31:34   336:06:53:33   634     6   627   GWM     1      3      0      5     3       67      69     0
  4  1977   336:06:54:14   336:09:11:27   612     5   606   QUI     2      1      0      1     1       66      65     0
  5  1977   336:09:12:49   336:10:40:53   395     4   390   QUI     2      2      0      2     1       15      14     0
  6  1977   336:10:41:34   336:10:51:07    47     1    45   QUI     2      3      0      0     0       29      28     0
  7  1977   336:10:51:48   336:12:35:34   464     4   459   BDA     2      4      0      3     2      127     125     0
  8  1977   336:12:37:37   336:13:09:42   147     2   144   HAW     2      5      0      1     1        1       1     0
  9  1977   336:13:10:23   336:13:59:32   222     2   219   ACN     3      1      0      0     0        0       0     0
 10  1977   336:14:00:13   336:16:22:13   634     6   627   ACN     4      1      0      0     0        0       0     0
 11  1977   336:16:23:35   336:18:48:59   646     6   639   HAW     4      2      1      4     3       79      77     0
 12  1977   336:18:50:21   336:21:06:53   609     5   603   ACN     5      1      0      6     3      185     191     0
 13  1977   336:21:07:34   336:22:05:36   262     3   258   HAW     5      2      0      1     1      105     104     0
 14  1977   336:22:06:17   336:23:44:35   440     4   435   HAW     5      3      0      0     0        0       0     0
 15  1977   336:23:45:16   337:01:59:45   597     5   591   ACN     6      1      0      4     3      140     139     0

*** END OF TAPE CHECK ***

@FREE       A1A-W

@XQT        TC2/HEAO
```

Figure 5-15. Tape Check Program Sample Output

```
    STA PE FILE # P  EDIT    DAY START   STOP        EXP   EXP   EXP   EXP   EXP   EXP   EXP
        YYDDDHHMM D YDDDTF       HH MM  HH MM        A-1   A-2A  A-2B  A-2C  A-3   A-4   DCM
                  F                                  T  F  T  F  T  F  T  F  T  F  T  F  T  F

  1 ACN 781551032 D 81551B   155 02:33  02:43        1  1  1  1  1  1  1  1  1  1  1  1
  2 QUI 781550341 D 81551C   155 02:44  03:08        1  2  1  2  1  2  1  2  1  2  1  2
  3 QUI 781550341 D 81551D   155 03:31  03:40        1  3  1  3  1  3  1  3  1  3  1  3
  4 HAW 781551129 D 81551E   155 03:43  03:46        1  4  1  4  1  4  1  4  1  4  1  4
  5 QUI 781550516 D 81551F   155 03:54  05:16        1  5  1  5  1  5  1  5  1  5  1  5
  6 ACN 781551032 D 81551G   155 05:17  07:09        1  6  1  6  1  6  1  6  1  6  1  6
  7 HAW 781550952 D 81551H   155 07:09  08:18        1  7  1  7  1  7  1  7  1  7  1  7
  8 HAW 781551129 D 81551I   155 08:19  11:16        2  1  1  8  1  8  1  8  1  8  1  8
  9 ACN 781551211 D 81551J   155 11:17  12:10        2  2  1  9  1  9  1  9  1  9  1  9
 10 ACN 781551351 D 81552A   155 12:11  13:50        2  3  1 10  1 10  1 10  1 10  1 10
 11 HAW 781551446 D 81552B   155 13:51  13:59        2  4  1 11  1 11  1 11  1 11  1 11
 12 HAW 781551446 D 81552C   155 14:00  14:48        3  1  2  1  2  1  2  1  2  1  2  1
 13 HAW 781551625 D 81552D   155 14:50  16:26        3  2  2  2  2  2  2  2  2  2  2  2
 14 HAW 781551807 D 81552E   155 16:28  18:04        3  3  2  3  2  3  2  3  2  3  2  3
 15 GWM 781551930 D 81552F   155 18:05  19:31        3  4  2  4  2  4  2  4  2  4  2  4
 16 ACN 781552026 D 81552G   155 19:32  20:25        4  1  2  5  2  5  2  5  2  5  2  5
 17 GWM 781552109 D 81552H   155 20:25  21:08        4  2  2  6  2  6  2  6  2  6  2  6
 18 GWM 781552248 D 81552I   155 21:10  22:47        4  3  2  7  2  7  2  7  2  7  2  7
 19 HAW 781561216 D 81553A   155 22:48  23:28        4  4  2  8  2  8  2  8  2  8  2  8
 20 QUI 781560107 D 81553B   155 23:41  01:07        4  5  2  9  2  9  2  9  2  9  2  9
 21 QUI 781560245 D 81553C   156 01:08  01:59        4  6  2 10  2 10  2 10  2 10  2 10

                   TOTAL NUMBER OF FILES --  21


  A-1  J.JOHNSON/NRL         A-3  SCHWARZ/SAO        A-4  HOFFMAN/MIT
  A-2A ROTHSCHILD/GSFC       A-2B GARMIRE/CIT        A-2C BOWYER/UCB


  THIS COPY IS TO BE RETAINED FOR YOUR INFORMATION.

     PLEASE SIGN AND RETURN THE ATTACHED RECEIPT FORM TO --

  DIGITAL DATA ACCOUNTING OFFICE
  DIGITAL DATA CONTROLLER
  NASA GODDARD SPACE FLIGHT CENTER , CODE 564
  GREENBELT , MARYLAND    20771
```

Figure 5-16. Sample Shipping Letter

the data files, the start and stop times of the data files on each tape, and the edit data files associated with each file of decommutated data. An enclosed tape receipt card must be signed by the experimenter and returned to the GSFC IPD. The shipment and distribution of tapes are discussed in paragraph 5.2.14.

The SMM experimenters will periodically receive a Data File Summary Tape which contains (chronologically) all data set labels from the beginning of the data year. Each file on the tape will contain all data set labels for a single data day. The number of files on the summary tape will thus increase throughout the processing year. This information will be used by experimenter to catalog the data sets, and it will facilitate the subsequent manipulation of the data. The first record of each tape file contains a short summary about the data set labels to follow. Figure 5-17 gives the format of the data file summary tape.

RECORD 1		
16-BIT WORD	BYTE	DESCRIPTION
1	MSB	FILE NO. OF THIS FILE
	LSB	DATA TYPE = 20, VOL. LABEL
2		RECORD NO. OF THIS RECORD
3-4		YEAR OF TAPE VOLUME
5-6		START DAY COUNT OF TAPE VOLUME (1-366)
7-8		START TIME OF TAPE VOLUME (MILLISECONDS OF DAY)
9-10		STOP DAY COUNT OF TAPE VOLUME
11-12		STOP TIME OF TAPE VOLUME (MILLISECONDS OF DAY)
13-14		NO. OF DATA SETS ON EXPERIMENTER TAPE VOLUME
15-16		DECOM NO.
17-54		SPARES

RECORD 2
DATA SET LABEL (REFER TO TABLE 5-7) OF FIRST DATA SET IN DATA DAY

RECORD 3
DATA SET LABEL OF SECOND DATA SET IN THE DATA DAY

● ● ● ●

RECORD N
DATA SET LABEL OF LAST DATA SET IN THE DATA DAY

EOF MARK

NEXT FILES ARE FORMATTED AS ABOVE

DOUBLE EOF MARK

Figure 5-17. Format of Data File Summary Tape

5.2.6 Data Tape Format for HXIS Experiment

The format of the HXIS experimenter data tape is shown in Figure 5-18 and Table 5-9. The data tape will contain as many files as can be packed on one 9-track production data tape written with a density of 1600 bpi. Copies of the HXIS production tape, with a tape density of 800 bpi, will be made available to the co-investigator at the University of Birmingham.

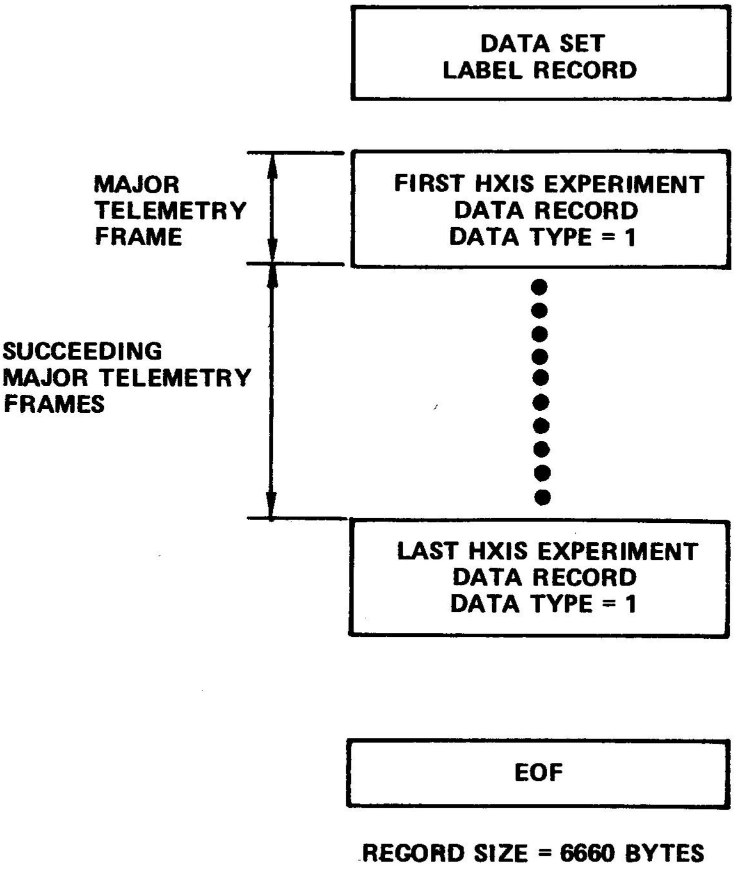


Figure 5-18. Decommutation Format for HXIS Data File

Table 5-9
SMM Data Tape Format for Hard X-ray Imaging Spectrometer

Byte	Description
1	File No. of this file
2	Data Type = 1 HXIS Data Record
3-4	Sequential record number in data file
5-6	Day-count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)
7-12	Milliseconds of day, U.T., at minor frame 0
13	Spare
14-16	Spacecraft clock at minor frame 0
17	Minor frame pointer to format change
18	M-Flag
19-82	F-Map
83	D(32,0) Flare Alert (MSB)
84	D(33,0) Flare Alert (LSB)
85	D(32,32) Flare Alert (MSB)
86	D(33,32) Flare Alert (LSB)
87	D(32,64) Flare Alert (MSB)
88	D(33,64) Flare Alert (LSB)
89	D(32,96) Flare Alert (MSB)
90	D(33,96) Flare Alert (LSB)
91	D(32,5) Status Micropro. 1
92	D(32,6) Status Micropro. 2
93	D(32,10) ANE Status 1
94	D(32,26) ANE Status 3
95	D(32,42) ANE Status 2
96	D(32,58) ANE Status 3
97	D(32,74) ANE Status 1
98	D(32,90) ANE Status 3
99	D(32,106) ANE Status 2
100	D(32,122) ANE Status 3
101	D(32,22) ANE Temp.
102	D(32,54) Detector Temp.
103	D(32,86) 1st Temp.
104	D(32,118) Collimator 1 Temp.
105	D(32,30) Collimator 2 Temp.
106	D(32,62) Pwr. Supply 1 Temp.
107	D(32,94) Pwr. Supply 2 Temp.
108	D(32,126) DHE Temp.
109	D(32,14) + 10 V Monitor Pwr. Supply 1
110	D(32,46) + 24 V Monitor Pwr. Supply 1
111	D(32,78) + 5 V Monitor Pwr. Supply 1
112	D(32,110) - 7 V Monitor Pwr. Supply 1
113	D(32,18) + 10 V Monitor Pwr. Supply 2
114	D(32,50) + 24 V Monitor Pwr. Supply 2
115	D(32,82) + 5 V Monitor Pwr. Supply 2
116	D(32,114) - 7 V Monitor Pwr. Supply 2
117	D(32,37) Photodiode 1
118	D(32,38) Photodiode 2
119	D(32,69) HV Monitor 1
120	D(32,70) HV Monitor 2
121	D(32,101) Pressure Monitor 1
122	D(32,102) Pressure Monitor 2

Table 5-9 (continued)

Byte	Description
123 + 40N	D(4, J)
124 + 40N	D(5, J)
125 + 40N	D(14, J)
126 + 40N	D(15, J)
127 + 40N	D(20, J)
128 + 40N	D(21, J)
129 + 40N	D(24, J)
130 + 40N	D(25, J)
131 + 40N	D(36, J)
132 + 40N	D(37, J)
133 + 40N	D(40, J)
134 + 40N	D(41, J)
135 + 40N	D(46, J)
136 + 40N	D(47, J)
137 + 40N	D(52, J)
138 + 40N	D(53, J)
139 + 40N	D(56, J)
140 + 40N	D(57, J)
141 + 40N	D(68, J)
142 + 40N	D(69, J)
143 + 40N	D(72, J)
144 + 40N	D(73, J)
145 + 40N	D(79, J)
146 + 40N	D(84, J)
147 + 40N	D(85, J)
148 + 40N	D(88, J)
149 + 40N	D(89, J)
150 + 40N	D(90, J)
151 + 40N	D(91, J)
152 + 40N	D(92, J)
153 + 40N	D(100, J)
154 + 40N	D(101, J)
155 + 40N	D(104, J)
156 + 40N	D(105, J)
157 + 40N	D(110, J)
158 + 40N	D(111, J)
159 + 40N	D(116, J)
160 + 40N	D(117, J)
161 + 40N	D(120, J)
162 + 40N	D(121, J)
5243 + 2N	D(22,J) Photodiode 1
5244 + 2N	D(23,J) ANE Status 3
5499 + 9N	D(35, J) OBC Data Word ID
5500 + 9N	D(80, J) OBC Data Word 1
5501 + 9N	D(81, J) OBC Data Word 2
5502 + 9N	D(82, J) OBC Data Word 3
5503 + 9N	D(83, J) OBC Data Word 4
5504 + 9N	D(112, J) OBC Data Word 5
5505 + 9N	D(113, J) OBC Data Word 6
5506 + 9N	D(114, J) OBC Data Word 7
5507 + 9N	D(115, J) OBC Data Word 8
6651-6660	Spares

Where $0 \leq N \leq 127$ and $0 \leq J \leq 127$
J is the minor frame number in the major frame

5.2.7 Data Tape Format for UVSP Experiment

The format of the UVSP experimenter data tape is shown in Figure 5-19 and Table 5-10. The data tape will contain as many files as can be packed on one 9-track production data tape written with a density of 1600 bpi.

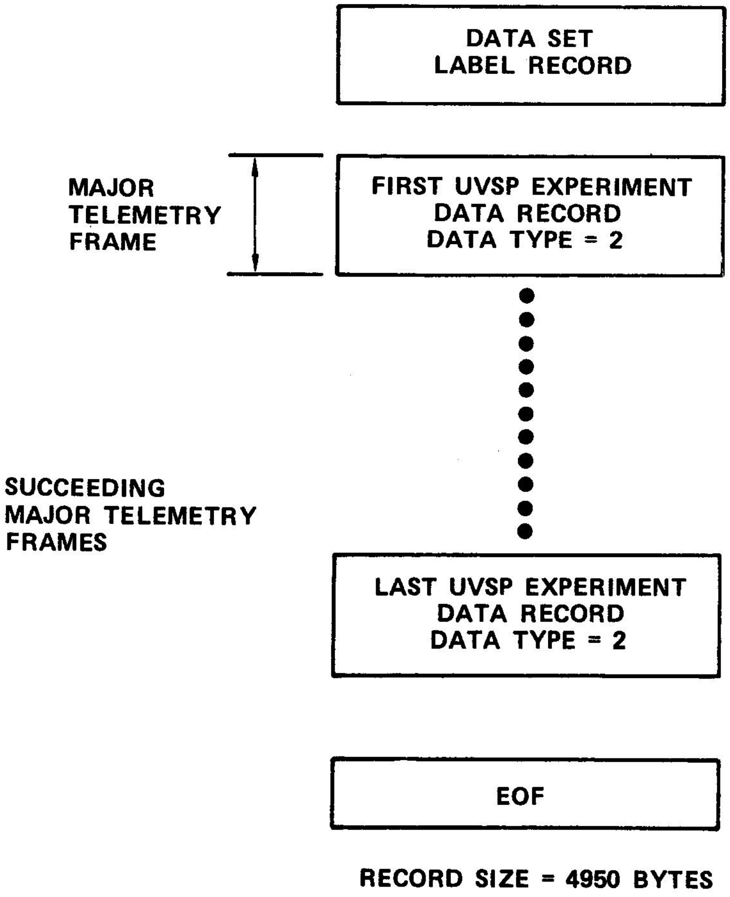


Figure 5-19. Decommutation Format for UVSP Data File

Table 5-10
SMM Data Tape Format for UVSP Experiment
(Marshall Space Flight Center)
Experiment No. 2

Byte	Description	
1	File No. of this file	
2	Data Type = 2 Data Record	
3-4	Sequential record number in data file	
5-6	Day-count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)	
7-12	Milliseconds of day, U.T., at minor frame 0	
13	Spare	
14-16	Spacecraft clock at minor frame 0	
17	Minor frame pointer to format change	
18	M-Flag	
19-82	F-Map	
83+38N	D(27,J)	UVSP Data
84+38N	D(28,J)	UVSP Data
85+38N	D(29,J)	UVSP Data
86+38N	D(30,J)	UVSP Data
87+38N	D(31,J)	UVSP Data
88+38N	D(62,J)	UVSP Data
89+38N	D(63,J)	UVSP Data
90+38N	D(94,J)	UVSP Data
91+38N	D(95,J)	UVSP Data
92+38N	D(126,J)	UVSP Data
93+38N	D(127,J)	UVSP Data
94+38N	D(35,J)	OBC Data Word ID
95+38N	D(80,J)	OBC Data Word 1
96+38N	D(81,J)	OBC Data Word 2
97+38N	D(82,J)	OBC Data Word 3
98+38N	D(83,J)	OBC Data Word 4
99+38N	D(112,J)	OBC Data Word 5
100+38N	D(113,J)	OBC Data Word 6
101+38N	D(114,J)	OBC Data Word 7
102+38N	D(115,J)	OBC Data Word 8

Table 5-10 (Continued)

Byte	Description	
103+38N	D(32, J)	Subcommutator 1
104+38N	D(33, J)	Subcommutator 2
105+38N	D(96, J)	Subcommutator 3
106+38N	D(97, J)	Subcommutator 4
107+38N	D(98, J)	Subcommutator 5
108+38N	D(99, J)	Subcommutator 6
109+38N	D(87, J)	S/C Clock
110+38N	D(86, J)	S/C Clock
111+38N	D(64, J)	S/C Clock
112+38N	D(65, J)	Frame Counter
113+38N	D(66, J)	CMD Counter
114+38N	D(22, J)	S/C Data
115+38N	D(23, J)	S/C Data
116+38N	D(60, J)	S/C Data
117+38N	D(61, J)	S/C Data
118+38N	D(124, J)	S/C Data
119+38N	D(125, J)	S/C Data
120+38N	Spare	
4947-4950	Spares	

Where $0 \le N \le 127$ and $0 \le J \le 127$
J is the minor frame number in the major frame.

5.2.8 Data Tape Format for WLCP Experiment

The three possible formats of the WLCP experimenter data tape are shown in Figure 5-20 and Table 5-11, in Figure 5-21, Table 5-12, Figure 5-22 and Table 5-13. The data tape will contain as many files as can be packed on one 9-track production data tape written with a density of 1600 bpi.

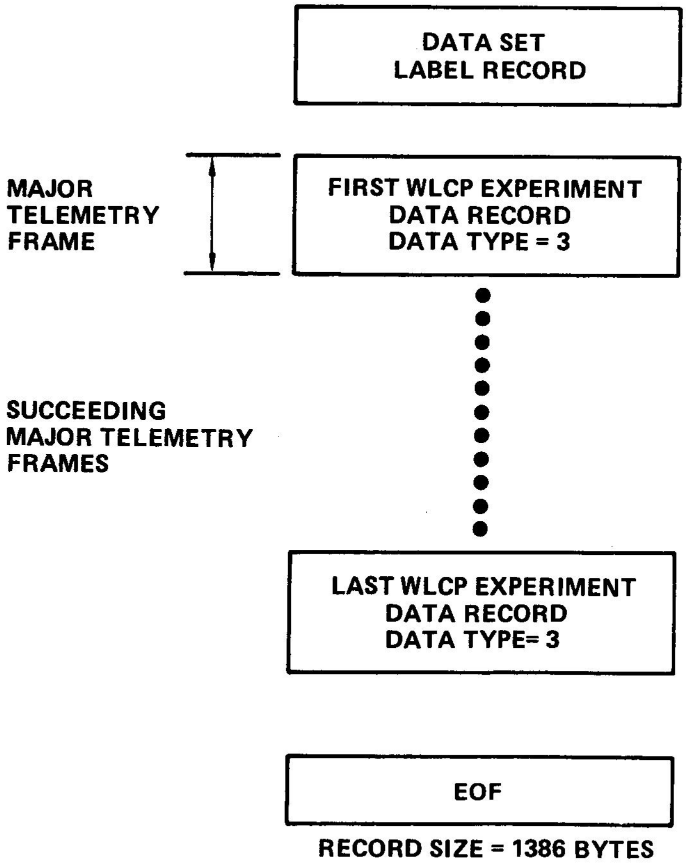


Figure 5-20. Decommutation Format for WLCP Experiment Data File

Table 5-11
SMM Data Tape Format for WLCP Experiment (High Altitude Observatory)
Experiment No. 3

Byte	Description
1	File No. of this file
2	Data type = 3 WLCP data record
3-4	Sequential record number in data file
5-6	Day-count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)
7-12	Milliseconds of day, U.T., at minor frame 0
13	HAO data type (see byte 92 in label, = 1 or 3)
14-16	Spacecraft clock at minor frame 0
17	Minor frame pointer to format change
18	M-flag
19-82	F-Map
82+N	D(78, J) WLCP data word
211	D(32, 4) G2 HV status
212	D(32, 12)01 temp.
213	D(32, 20) Quad 1 temp.
214	D(32, 28) Quad 1 temp.
215	D(32, 36) Quad 2 temp.
216	D(32, 44) Quad 3 temp.
217	D(32, 52) Quad 4 temp.
218	D(32, 60) Quad 5 temp.
219	D(32, 68) Bilevel status
220	D(99, 4) HXRBS 01
221	D(99, 24) HXRBS 09
222	D(99, 27) HXRBS 10
223	D(99, 28) HXRBS 11
224	D(32, 00) Flare alert (MSB)
225	D(33, 00) Flare alert (LSB)
226	D(32, 32) Flare alert(MSB)
227	D(33, 32) Flare alert (LSB)
228	D(32, 64) Flare alert (MSB)
229	D(33, 64) Flare alert (LSB)
230	D(32, 96) Flare alert (MSB)
231	D(33, 96) Flare alert (LSB)
232+9N	D(35, J) OBC data word Id
233+9N	D(80, J) OBC data word 1
234+9N	D(81, J) OBC data word 2
235+9N	D(82, J) OBC data word 3
236+9N	D(83, J) OBC data word 4
237+9N	D(112, J) OBC data word 5
238+9N	D(113, J) OBC data word 6
239+9N	D(114, J) OBC data word 7
240+9N	D(115, J) OBC data word 8
1384	D(33, 5) FPSS 1 and 2 bilevel Sun Present/absent signal
1385-1386	Spares

Where $0 \leq N \leq 127$ and $0 \leq J \leq 127 \leq J$ is the minor frame number

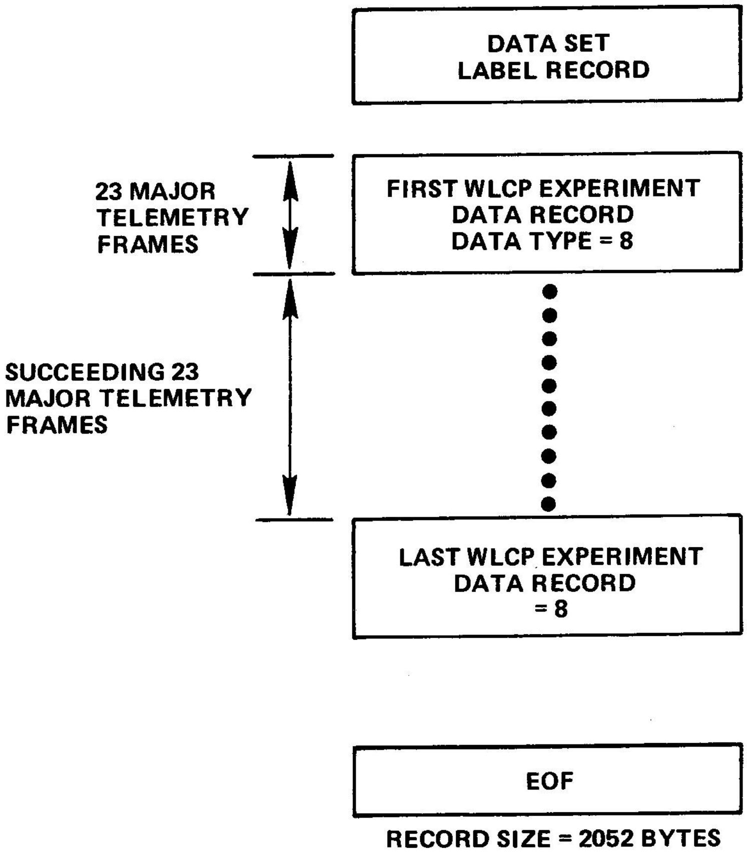

DATA SET
LABEL RECORD
23 MAJOR TELEMETRY FRAMES
FIRST WLCP EXPERIMENT DATA RECORD DATA TYPE = 8
SUCCEEDING 23 MAJOR TELEMETRY FRAMES
LAST WLCP EXPERIMENT DATA RECORD = 8
EOF
RECORD SIZE = 2052 BYTES

Figure 5-21. Decommutation Format for WLCP Experiment Data File (Data Type = 8)

Table 5-12
SMM Data Tape Format for WLCP Experiment
(High Altitude Observatory)
Experiment No. 3

Byte	Description
1	File No. of this file
2	Data type = 8 WLCP data record when in dwell mode, but not dwelling on word 78
3-4	Sequential record number in data file
5-6	Day count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)
7-12	Milliseconds of day, U.T., at minor frame 0
13	HAO data type (see byte 92 in label, = 2)
14-16	Spacecraft clock at minor frame 0
17	Minor frame pointer to format change
18	M-Flag
19-82	F-Map
83	D(32,4) G2 HV status
84	D(32,12) 01 Temp.
85	D(32,20) 02 Temp.
86	D(32,28) Quad 1 Temp.
87	D(32,36) Quad 2 Temp.
88	D(32,44) Quad 3 Temp.
89	D(32,52) Quad 4 Temp.
90	D(32,60)
91	D(32,68) Bilevel status
92-2005	Repeat bytes 5-91 for the next 22 major frames
2006-2052	Spares

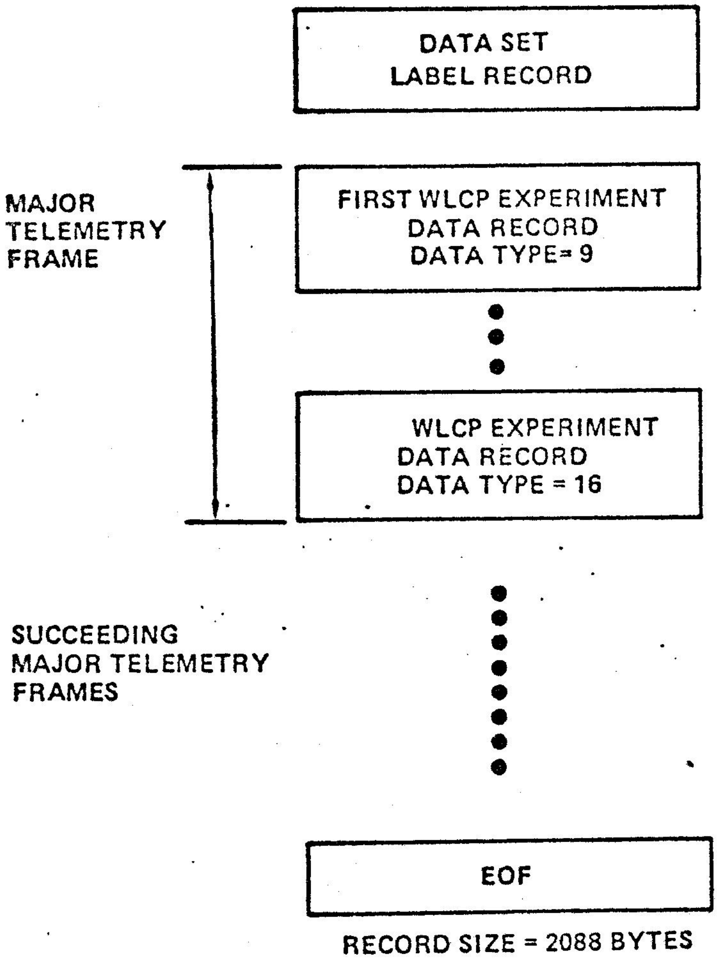


Figure 5-22. Decommutation Format for WLCP Experiment Data File
(Data Type = 9 -16)

Table 5-13
SMM Data Tape Format for WLCP Experiment
(High Altitude Observatory)
Experiment No. 3

Byte	Description
1	File No. of this file
2	Data type = 9 WLCP data record for minor frames 0-15 = 10 for minor frames 16-31 = 11 for minor frames 32-47 = 12 for minor frames 48-63 = 13 for minor frames 64-79 = 14 for minor frames 80-95 = 15 for minor frames 96-111 = 16 for minor frames 112-127
3-4	Sequential record number in data file
5-6	Day count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)
7-12	Milliseconds of day, U.T., at minor frame 0
13	HAO data type (see byte 92 in label, = 5,6,7, or 8)
14-16	Spacecraft clock at minor frame 0
17	Minor frame pointer to format change
18	M-Flag
19-26	F-Map for 16 minor frames to follow
27+128N	D(3,J)
28+128N	D(4,J)
29+128N	D(5,J)
30+128N	D(6,J)
o	SMM telemetry words are further decommutated
o	in sequential order
o	o
o	o
o	o
o	o
150+128N	D(126,J)
151+128N	D(127,J)
152+128N	D(0,J)
153+128N	D(1,J)
154+128N	D(2,J)
2075-2088	Spares

Where $0 \leq N \leq 15$ and $0 \leq J \leq 15$
or $16 \leq J \leq 31$
or $32 \leq J \leq 47$
or $48 \leq J \leq 63$
or $64 \leq J \leq 79$
or $80 \leq J \leq 95$
or $96 \leq J \leq 111$
or $112 \leq J \leq 127$

Where J is the minor frame number
Note: The final data record(s) will be padded out with fill data if necessary.

5.2.9 Data Tape Format for XRP Experiment

The format of the XRP experimenter data tape is shown in Figure 5-23 and Table 5-14. The data tape will contain as many files as can be packed on one 9-track production data tape written with a density of 1600 bpi. The XRP production data tapes will be sent to the Experiment Operations Facility at GSFC. Copies of the tapes will be made available to the co-investigators at Lockheed Palo Alto Research Laboratory, Mullard Space Sciences Laboratory, and the Appleton Research Department. All tape copies will be produced at 1600 bpi tape density.

p. 5-47 fig 5-23
Second block down should be labelled "FIRST Data Record".
Next block down should be labelled "LAST Data Record".
Label at left of second block should read
"Major Telemetry Frame" (not "Frames").

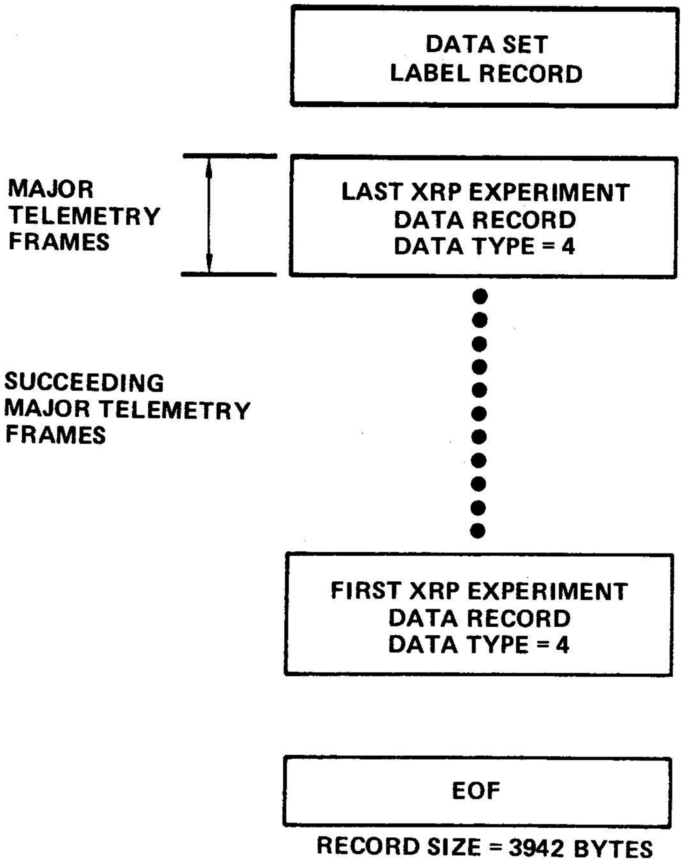


Figure 5-23. Decommutation Format for XRP Experiment Data File

Table 5-14
SMM Data Tape Format for XRP Experiment
(Lockheed Palo Alto Research Laboratory)
Experiment No. 4

Byte	Description	
1	File No. of this file	
2	Data type = 4 XRP Data Record	
3-4	Sequential record number in data file	
5-6	Day-count from epoch 1979.0	
	(Day count 1 starts at 00:00:00 1/1/79)	
7-12	Milliseconds of day, U.T., at minor frame 0	
13	Spare	
14-16	Spacecraft clock at minor frame 0	
17	Minor frame pointer to format change	
18	M-Flag	
19-82	F-Map	
83-98	Spares	
99+N	D(109, J)	
227+13M	D(10, k)	FCS Science Array
228+13M	D(11, k)	
229+13M	D(26, k)	
230+13M	D(42, k)	
231+13M	D(43, k)	
232+13M	D(58, k)	
233+13M	D(59, k)	
234+13M	D(74, k)	
235+13M	D(75, k)	
236+13M	D(106, k)	
237+13M	D(107, k)	
238+13M	D(122, k)	
239+13M	D(123, k)	
643+13L	D(10, i)	BCS Science Array
644+13L	D(11, i)	
645+13L	D(26, i)	
646+13L	D(42, i)	
647+13L	D(43, i)	
648+13L	D(58, i)	

Table 5-14 (Continued)

Byte	Description	
649+13L	D(59, i)	
650+13L	D(74, i)	
651+13L	D(75, i)	
652+13L	D(106, i)	BCS Science Array
653+13L	D(107, i)	
654+13L	D(122, i)	
655+13L	D(123, i)	
1891+9N	D(35, J)	OBC Data Word ID
1892+9N	D(80, J)	OBC Data Word 1
1893+9N	D(81, J)	OBC Data Word 2
1894+9N	D(82, J)	OBC Data Word 3
1895+9N	D(83, J)	OBC Data Word 4
1896+9N	D(112, J)	OBC Data Word 5
1897+9N	D(113, J)	OBC Data Word 6
1898+9N	D(114, J)	OBC Data Word 7
1899+9N	D(115, J)	OBC Data Word 8
3043+6N	D(32, J)	Subcommutator 1
3044+6N	D(33, J)	Subcommutator 2
3045+6N	D(96, J)	Subcommutator 3
3046+6N	D(97, J)	Subcommutator 4
3047+6N	D(98, J)	Subcommutator 5
3048+6N	D(99, J)	Subcommutator 6
3811+N	D(65, J)	S/C minor frame counter
3939-3942	Spares	

Where: $0 \le N \le 127$ and $0 \le J \le 127$
$0 \le M \le 32$ and $k = 0, 4, 8, \ldots 124$
$0 \le L \le 96$ and $i = 1, 2, 3, 5, 6, 7, 9, 10, 11, \ldots, 125, 126, 127$

J, k, or i are minor frame numbers

5.2.10 Data Tape Format for GRE Experiment

The format of the GRE experimenter data tape is shown in Figure 5-24 and Table 5-15. The data tape will contain as many files as can be packed on one 9-track production data tape written with a density of 1600 bpi.

Copies of the GRE production data tapes will be made available to the GRE co-investigators at Naval Research Laboratory (NRL) and at the Max Planck Extra-terrestial Institute (MPE) as authorized by the SMM Project. The tape copies will be 9-track tapes at 1600 bpi for MPE and 7-track tapes at 556 bpi for NRL. Presently, NRL is investigating the feasibility in converting to 9-track 1600 bpi tapes in order to reduce the tape cost.

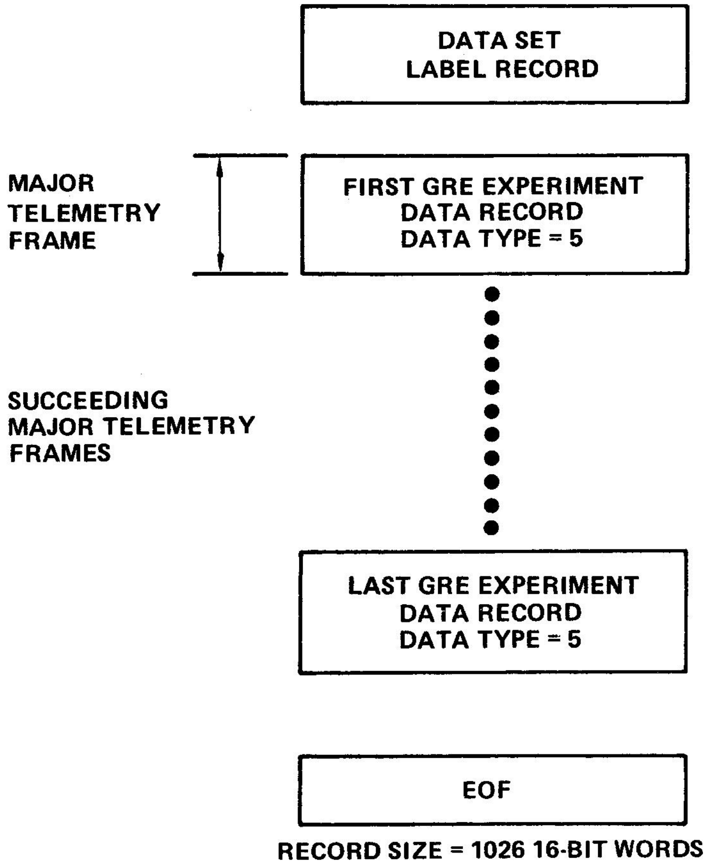


Figure 5-24. Decommutation Format for GRE Experiment Data File

Table 5-15
SMM Data Tape Format for GRE Experiment
(University of New Hampshire)
Experiment No. 5

16-bit Word	Byte	Description
1	MSB	File No. of this file
	LSB	Data Type = 5 GRE Data Record
2		Sequential record number in data file
3		Day-count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)
4-6		Milliseconds of day, U.T., at minor frame 0
7	MSB	Spare
	LSB	
8	MSB	Spacecraft clock at minor frame 0
	LSB	
9	MSB	Minor frame pointer to format change
	LSB	M-Flag
10-41		F-Map
42+3N	MSB	D(12,J)
	LSB	D(13,J)
43+3N	MSB	D(44,J)
	LSB	D(45,J)
44+3N	MSB	D(76,J)
	LSB	D(77,J)
426	MSB	D(99,04) HXRBS 01
	LSB	D(99,24) HXRBS 09
427	MSB	D(99,27) HXRBS 10
	LSB	D(99,28) HXRBS 11
428	MSB	D(32,03) HV Control 1A
	LSB	D(32,07) HV Control 1B
429	MSB	D(32,11) HV Control 2A
	LSB	D(32,19) HV Control 2B
430	MSB	D(32,23) HV Control 3A
	LSB	D(32,29) HV Control 3B
431	MSB	D(32,35) HV Control 4A
	LSB	D(32,39) HV Control 4B
432	MSB	D(32,43) HV Control 5A
	LSB	D(32,51) HV Control 5B
433	MSB	D(32,55) HV Control 6A
	LSB	D(32,59) HV Control 6B

Table 5-15 (Continued)

16-bit Word	Byte	Description
434	MSB	D(32,67) HV Control 7A
	LSB	D(32,71) HV Control 7B
435	MSB	D(32,75) HV Control 8A
	LSB	D(32,83) HV Control 8B
436	MSB	D(32,87) +5 V Bus A
	LSB	D(32,91) +5 V Bus B
437	MSB	D(32,99) +10 V Bus A
	LSB	D(32,103) +10 V Bus B
438	MSB	D(32,107) -10 V Bus A
	LSB	D(32,115) -10 V Bus B
439	MSB	D(32,119) Det. Temp. 1
	LSB	D(32,123) Det. Temp. 2
440	MSB	D(32,49) Elect. Temp.
	LSB	Spare
441	MSB	D(32,00) Flare Alert (MSB)
	LSB	D(33,00) Flare Alert (LSB)
442	MSB	D(32,32) Flare Alert (MSB)
	LSB	D(33,32) Flare Alert (LSB)
443	MSB	D(32,64) Flare Alert (MSB)
	LSB	D(33,64) Flare Alert (LSB)
444	MSB	D(32,96) Flare Alert (MSB)
	LSB	D(33,96) Flare Alert (LSB)
445	MSB	D(35,0) OBC Data Word ID
	LSB	D(80,0) OBC Data Word 1
446	MSB	D(81,0) OBC Data Word 2
	LSB	D(82,0) OBC Data Word 3
447	MSB	D(83,0) OBC Data Word 4
	LSB	D(112,0) OBC Data Word 5
448	MSB	D(113,0) OBC Data Word 6
	LSB	D(114,0) OBC Data Word 7
449	MSB	D(115,0) OBC Data Word 8
	LSB	Repeat the 9 OBC words for minor frames 1-127
450-1020		
1021-1026		Spares

Where 0 ≤ N ≤ 127 and 0 ≤ J ≤ 127

J is the minor frame number in the major frame.

5.2.11 Data Tape Format for HXRBS Experiment

The format of the HXRBS experimenter data tape is shown in Figure 5-25 and Table 5-16. The data tape will contain as many files as can be packed on one 9-track production data tape written with a density of 800 bpi.

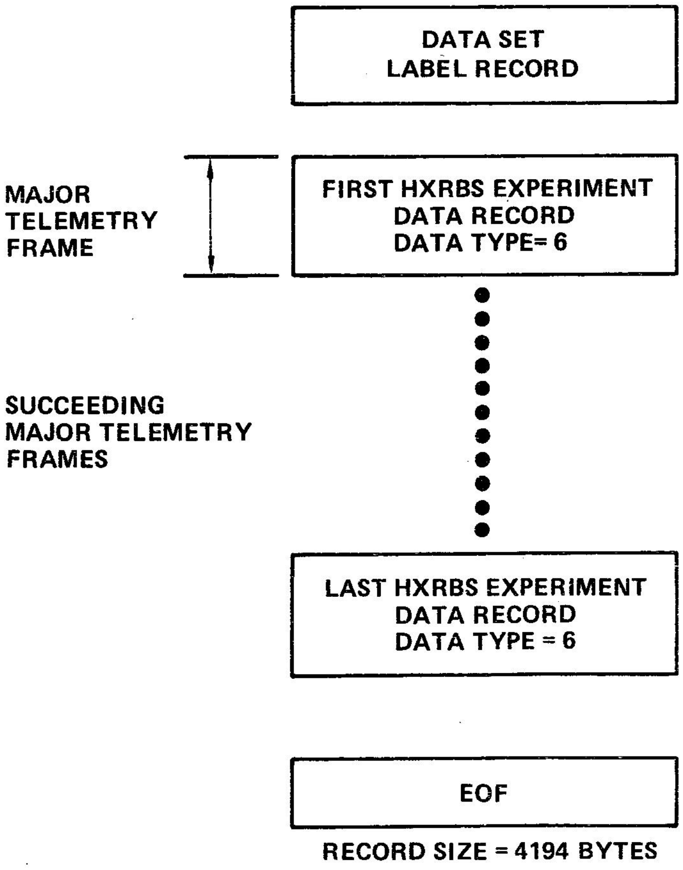


Figure 5-25. Decommutation Format for HXRBS Experiment Data File

Table 5-16
SMM Data Tape Format for HXRBS Experiment
GSFC
Experiment No. 6

Byte	Description	
1	File No. of this file	
2	Data Type = 6 Data Record	
3-4	Sequential record number in data file	
5-6	Day-count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)	
7-12	Milliseconds of day, U.T., at minor frame 0	
13	Spare	
14-16	Spacecraft clock at minor frame 0	
17	Minor frame pointer to format change	
18	M-Flag	
19-82	F-Map	
83+32N	D(6,J)	HXRBS22
84+32N	D(7,J)	HXRBS23
85+32N	D(38,J)	HXRBS24
86+32N	D(39,J)	HXRBS25
87+32N	D(54,J)	HXRBS26
88+32N	D(55,J)	HXRBS27
89+32N	D(70,J)	HXRBS28
90+32N	D(71,J)	HXRBS29
91+32N	D(102,J)	HXRBS30
92+32N	D(103,J)	HXRBS31
93+32N	D(118,J)	HXRBS32
94+32N	D(119,J)	HXRBS33
95+32N	D(99,J)	Subcommutator 6
96+32N	D(93,J)	SLLRA
97+32N	D(3,J)	TM Format ID
98+32N	D(87,J)	Spacecraft Clock
99+32N	D(86,J)	Spacecraft Clock
100+32N	D(64,J)	Spacecraft Clock
101+32N	D(67,J)	Dwell and Channel ID

Table 5-16 (Continued)

Byte	Description	
102+32N	D(35,J)	OBC Data Word ID
103+32N	D(80,J)	OBC Data Word 1
104+32N	D(81,J)	OBC Data Word 2
105+32N	D(82,J)	OBC Data Word 3
106+32N	D(83,J)	OBC Data Word 4
107+32N	D(112,J)	OBC Data Word 5
108+32N	D(113,J)	OBC Data Word 6
109+32N	D(114,J)	OBC Data Word 7
110+32N	D(115,J)	OBC Data Word 8
111+32N	D(65,J)	Frame Counter
112+32N	D(O,J)	Frame Synch
113+32N	D(1,J)	Frame Synch
114+32N	D(2,J)	Frame Synch
4179-4194	Spares	

Where $0 \leq N \leq 127$ and $0 \leq J \leq 127$
J is the minor frame number in the major frame.

5.2.12 Data Tape Format for ACRIM Experiment

The format of the ACRIM experimenter data tape is shown in Figure 5-26 and Table 5-17. The data tape will contain as many files as can be packed on one 9-track production data tape written with a density of 800 bpi.

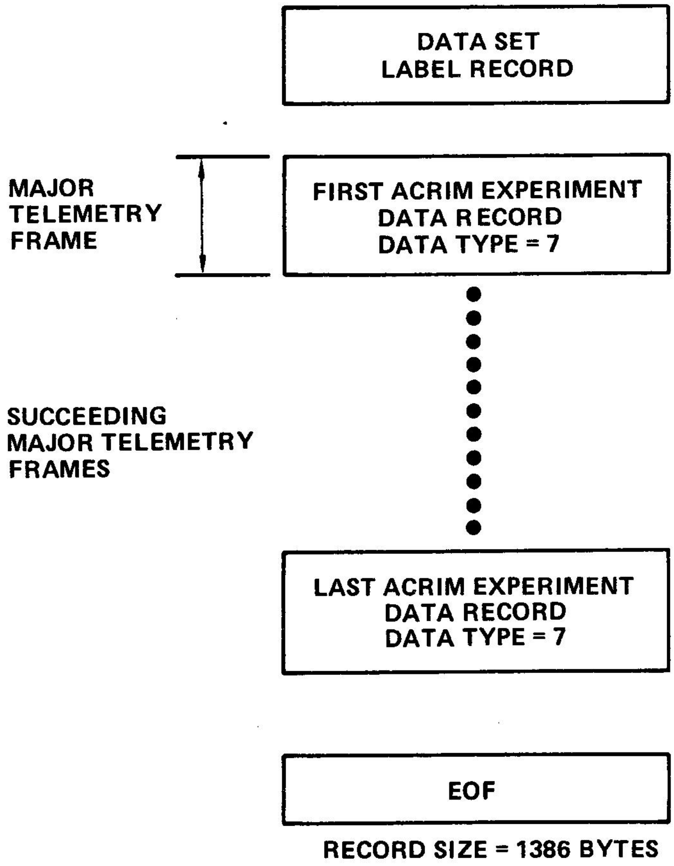

DATA SET
LABEL RECORD
MAJOR TELEMETRY FRAME
FIRST ACRIM EXPERIMENT DATA RECORD DATA TYPE = 7
SUCCEEDING MAJOR TELEMETRY FRAMES
LAST ACRIM EXPERIMENT DATA RECORD DATA TYPE = 7
EOF
RECORD SIZE = 1386 BYTES

Figure 5-26. Decommutation Format for ACRIM Experiment Data File

Table 5-17
SMM Data Tape Format for ACRIM Experiment
JPL
Experiment No. 7

Byte	Description
1	File No. of this file
2	Data Type = 7 ACRIM Data Record
3-4	Sequential record number in data file
5-6	Day-count from epoch 1979.0 (Day count 1 starts at 00:00:00 1/1/79)
7-12	Milliseconds of day, U.T., at minor frame 0
13	Spare
14-16	Spacecraft clock at minor frame 0
17	Minor frame pointer to format change
18	M-Flag
19-82	F-Map
83	D(32,13) MT-1
84	D(32,15) MT-2
85	D(32,31) MT-3
86	D(32,45) MT-4
87	D(32,47) ET-1
88	D(32,63) ET-2
89	D(32,77) ET-3
90	D(32,79) ET-4
91	D(32,95) +5 V
92	D(32,00) Flare Alert (MSB)
93	D(33,00) Flare Alert (LSB)
94	D(32,32) Flare Alert (MSB)
95	D(33,32) Flare Alert (LSB)
96	D(32,64) Flare Alert (MSB)
97	D(33,64) Flare Alert (LSB)
98	D(32,96) Flare Alert (MSB)
99	D(33,96) Flare Alert (LSB)
100+N	D(108,J) ACRIM Science Data

Table 5-17 (Continued)

Byte	Description	
228+9N	D(35, J)	OBC Data Word ID
229+9N	D(80, J)	OBC Data Word 1
230+9N	D(81, J)	OBC Data Word 2
231+9N	D(82, J)	OBC Data Word 3
232+9N	D(83, J)	OBC Data Word 4
233+9N	D(112, J)	OBC Data Word 5
234+9N	D(113, J)	OBC Data Word 6
235+9N	D(114, J)	OBC Data Word 7
236+9N	D(115, J)	OBC Data Word 8
1379-1386	Spares	

Where $0 \leq N \leq 127$ and $0 \leq J \leq 127$
J is the minor frame number in the major frame.

5.2.13 Processing of HAO Video Data

The HAO Coronograph and Polarimeter experiment utilizes a dedicated standard onboard tape recorder to accumulate most of the experiment's scientific data. The HAO tape recorder is played back at GSTDN stations and the data are forwarded to GSFC/IPD as PDF E, G, I, or K. The playback of the data is in reverse order. TELOPS will receive the four PDF's and perform a pre-edit function including the reversal of the data stream. An 1108 applications program will prepare the production data tapes of the HAO video data. The production data tapes containing the dedicated HAO tape recorder data will be 9-track tapes written with odd parity and a density of 1600 bpi. Each file will be started with a label record, as shown in Table 5-7, and will be followed by the data records, formatted as shown in Figure 5-27 and Table 5-18. Bytes 77 to 90 of the label will contain zero data because the label is not applicable to the dedicated tape recorder data. An end-of-file (EOF) mark closes a file. An end of tape is indicated by two successive EOF marks. Long tape recorder dumps of the HAO recorder may be contained on two production tapes. The M-Flag and the F-Map are described in paragraph 5.2.5.

Alternately, the HAO video can be transmitted as 256 Kbs real-time data from the spacecraft, and is in the same format as the playback data except it is in the forward direction. The data is also received at GSTDN and forwarded to IPD/GSFC as PDF C. TELOPS will perform a pre-edit function, except it will not reverse the data as performed for the HAO playback data. The UNIVAC 1108 application program will prepare the production data in the same format as previously discussed.

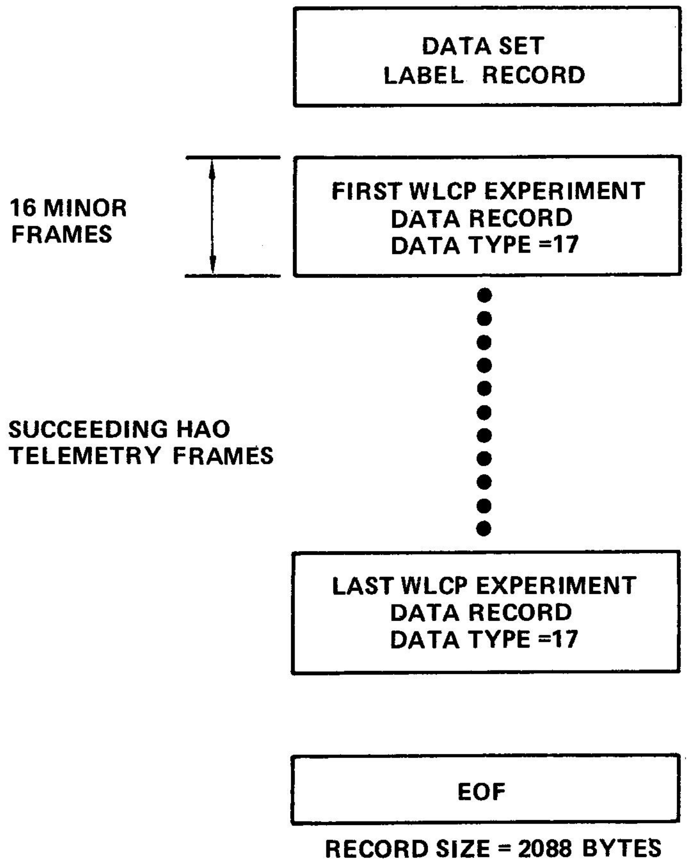


Figure 5-27. Production Tape Format for HAO Video Data File

Table 5-18
Format for Data from HAO Dedicated Tape Recorder SMM Data Tape Format for WLCP Experiment (High Altitude Observatory)

Byte	Description
1	File No. of this file
2	Data type = 17 HAO video data record
3-4	Sequential record number in data file
5-6	Day-count from epoch 1979.0 (Day count starts at 00:00:00 1/1/79)
7-12	Milliseconds of day, downlink dump time U.T., of first minor frame in record
13	HAO data type (see byte 92 in label, = 4)
14-17	Milliseconds of day of last minor frame in record
18	M-Flag for 16 minor frames to follow
19-26	F-Map for 16 minor frames to follow (last data record will indicate fill for padded out fill data)
27+128N	D(3,J)
28+128N	D(4,J)
29+128N	D(5,J)
30+128N	D(6,J)
o	o
o	o
o	o
o	SMM telemetry words are further decommutated in sequential order
o	o
o	o
150+128N	D(126,J)
151+128N	D(127,J)
152+128N	D(0,J)
153+128N	D(1,J)
154+128N	D(2,J)
2075-2088	Spares

Where $0 \leq N \leq 15$ and $0 \leq J \leq 15$

J represents sequential minor frames after data reversal of the downlink HAO tape recorder dump.

Note: If necessary, the last record will be padded out with zero fill data following the last minor frame of data.

5.2.14 Shipment of Data Tapes

After the analyst has analyzed the production output, he will release the output data tapes through Digital Shipping and Receiving (DS&R) by submitting to the Dispatch Office a release of shipment form with the corresponding shipping letters (one for each experimenter) attached. One copy will be kept on file by the analyst as a permanent record of released data tapes. DS&R will pack the tapes into boxes, label the boxes, and ship them by mail (regular or air mail). A tape receipt form will be attached to the outside of the tape container. Upon receipt of the tape, the experimenter will sign the receipt and mail it back to DS&R. The experimenter decommutated tapes will be distributed as listed in Table 5-19. Inventory numbers will be assigned to all tapes for control and accounting purposes.

Table 5-19
Experimenter Tape Distribution

Tape Identification	Recipient
X-1A	Dr. Peter Hoyng Space Research Laboratory Beneluxlaan 21 3527HS Utrecht The Netherlands
X-1C	Dr. George Simnett Department of Space Research University of Birmingham P. O. Box 363 Birmingham, B15 2TT United Kingdom
X-2	Dr. Richard A. Shine Code 685 Bldg. 21, Rm. 106 NASA/GSFC
X-3	Dr. Ernest Hildner High Altitude Observatory National Center for Atmospheric Research P. O. Box 3000 Boulder, CO 80307

Table 5-19 (Continued)

Tape Identification	Recipient
X-4A	Mr. D. T. Roethig Department 52-12, Building 202 Lockheed Palo Alto Research Laboratory 3251 Hanover Street Palo Alto, CA 94304
X-4B	Dr. A. H. Gabriel Astrophysics Research Division Culham Laboratory Abingdon, Oxfordshire, OX 14 3DB United Kingdom
X-4C	Dr. J. L. Culhane University College, London Mullard Space Science Laboratory Holmbury St. Mary Durking, Surrey United Kingdom
X-4D	Dr. J. C. Sherman XRP EOF Area, Bldg. 7 NASA/GSFC
X-5A	Dr. E. Chupp Physics Department University of New Hampshire Durham, NH 03824
X-5B	Dr. Gerald Share Naval Research Laboratory Code 7128.4 4555 Overlook Ave., S.W. Washington, D.C. 20375

Table 5-19 (Continued)

Tape Identification	Recipient
X-5C	Dr. C. Reppin Max Planck Institute Extra Terrestrial Physics 8046 Garching - b. Muenchen West Germany
X-6	Mr. Ken Frost Code 684 Bldg. 21, Rm. G14 NASA/GSFC
X-7	Dr. R. Willson Jet Propulsion Laboratory 4800 Oak Grove Drive Pasadena, CA 91103

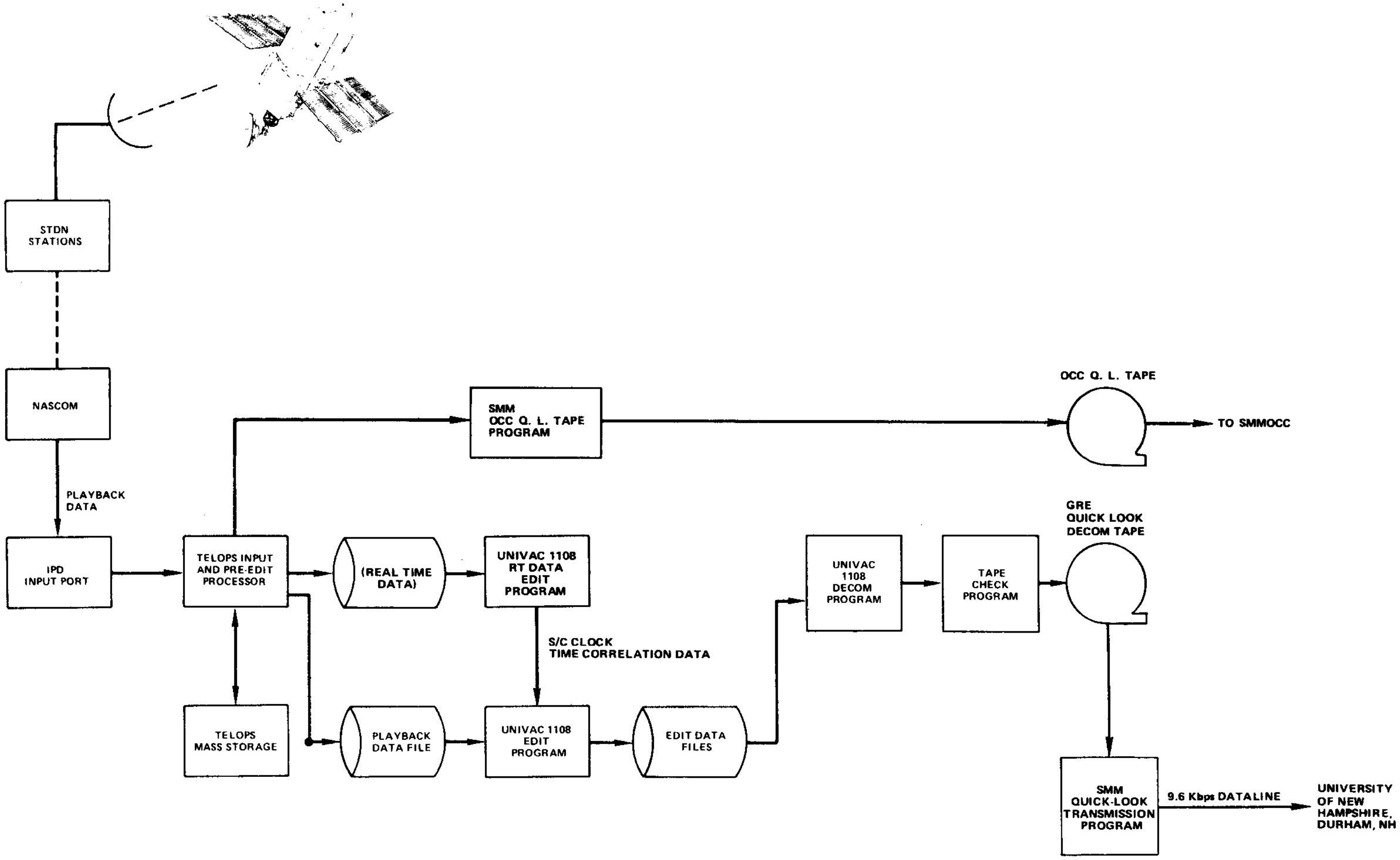
5.3 QUICK-LOOK PROCESSING

5.3.1 General

Quick-look data will be processed to produce two pre-scheduled orbits of quick-look data on magnetic tape for the SMMOCC within eight hours of acquisition.

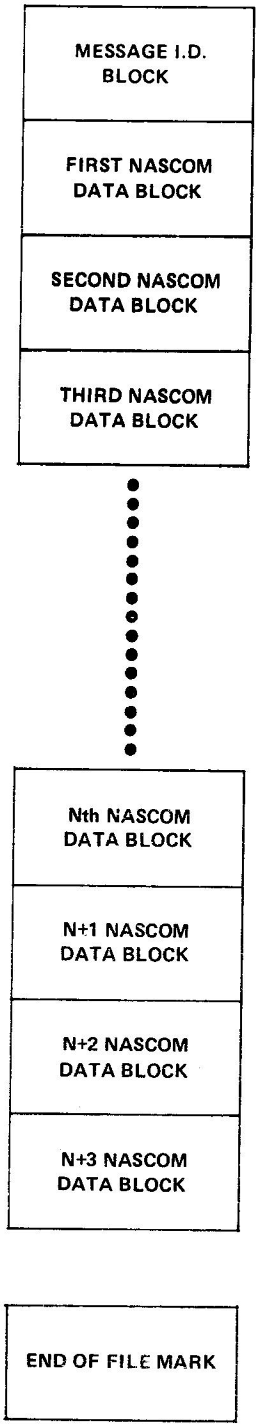
Quick-look data will also be transmitted over a data phone circuit (9.6 kbps data rate) to the experimenter at the University of New Hampshire, Durham, New Hampshire. The quick-look transmissions will normally be performed in a batch mode every day. One orbit of quick-look data is transmitted daily to the University of New Hampshire within 24 hours of acquisition. Figure 5-28 shows the data flow for quick-look processing. The quick-look data tapes for the SMMOCC will be prepared in a format as shown in Figure 5-29. The playback data will be taken from TELOPS or from the Data Capture System (DCS). A tape will then be made in the SMMOCC data tape format. The playback data are not reversed as requested by the SMMOCC.

The SMM-A experiment quick-look data transmissions will consist of spacecraft tape recorder dump data forwarded to IPD from the STDN stations. The playback data will be received by TELOPS, quality checked, unpacked from the NASCOM blocks, and reversed by the TELOPS pre-edit program. A cataloged pre-edit file is created for each tape recorder dump. The data will be edited and decommutated in the established production decom format. The GRE decom tape will be carried to a separate computer where a program will read the data from the decom tape and prepare the data for transmission to the University of New Hampshire via the data line. The data are transmitted via the duplex phone line according to the International Communications Standard X 2.5 levels 2 and 3. The transmission protocol is implemented mainly through microprocessor communications support chips available on the commercial market.



STDN STATIONS
NASCOM
PLAYBACK DATA
IPD INPUT PORT
TELOPS INPUT AND PRE-EDIT PROCESSOR
TELOPS MASS STORAGE
SMM OCC Q. L. TAPE PROGRAM
OCC Q. L. TAPE
TO SMMOCC
(REAL TIME DATA)
UNIVAC 1108 RT DATA EDIT PROGRAM
S/C CLOCK TIME CORRELATION DATA
PLAYBACK DATA FILE
UNIVAC 1108 EDIT PROGRAM
EDIT DATA FILES
UNIVAC 1108 DECOM PROGRAM
TAPE CHECK PROGRAM
GRE QUICK LOOK DECOM TAPE
SMM QUICK-LOOK TRANSMISSION PROGRAM
9.6 Kbps DATALINE
UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NH

Figure 5-28. SMM Data Flow for Quick-look Processing



NOTE: FOUR NASCOM BLOCKS PER DATA RECORD
RECORD LENGTH = 2400 BYTES

Figure 5-29. Format of Quick-look Data Tape for SMMOCC

X-565-78-20

SMM-A Data Processing Plan - errata

p. 5-24 Item 15. additional note: P13YYDDDHHMMSSSVƀSSSƀX
Item 20. additional note: ƀXƀ

p. 5-25 fig 5-13. The leftmost block should state "Data Set Label Record".

p. 5-27 byte 102 (LSB) should be "X-1B-W".

p. 5-34 replace with attached page

p. 5-45 replace with attached page

p. 5-47 fig 5-23
Second block down should be labelled "FIRST Data Record".
Next block down should be labelled "LAST Data Record".
Label at left of second block should read "Major Telemetry Frame" (not "Frames").

GLOSSARY

GLOSSARY

A

A	Analog data from an active source
Å	Angstrom unit
ACDS	Attitude control and determination system
ACRIM	Active cavity radiometer irradiance monitor
ACN	Ascension Island STDN station
ACS	Attitude Control Subsystem
AFO	Announcement of flight opportunity
AGO	Santiago, Chile STDN station
AOS	Acquisition, or arrival, of signal
AP	Application program
ATM	Apollo telescope mount

B

BDA	Bermuda STDN station
BIT NBR	Bit number assigned to a bilevel signal within data word
bpi	Bits per inch
bps	Bits per second
BSC	Block sequence count

C

C	Analog data from a passive transducer
CDHS	Command and data handling system
CH	Channel
CHAR	Character
CIIS	Control integrated information system
cm	Centimeter
CMD	Command
CMS	Command management system
CPU	Central processing unit
CRT	Cathode ray tube
CU	Central unit
C/DH	Communications and data handling subsystem

GLOSSARY (continued)

D

D	Bilevel digital data word
dB	Decibel
dBi	Decibel isotropic
dBm	Decibel referred to 1 milliwatt
deg	Degree
DIG WORD	Grouping of 8 bilevel bits into one word
DMA	Direct memory access
DOD	Department of Defense
DRL	Data Reduction Laboratory
DS&R	Digital shipping and receiving
DTU	Data transmission unit

E

EBCDIC	Extended BCD interchange code
EOF	End of file
ERTS	Earth Resources Technology Satellite (LANDSAT)
ETR	Eastern Test Range (Kennedy Space Flight Center)
e.g.	For example

F

FD	Fieldata
FM	Frequency modulation
FPTA	Focal-plane transport assembly
FRM	Frame

G

GDS	Goldstone STDN station
GMI	Goddard Management Instruction
GMT	Greenwich Mean Time
GRE	Gamma ray experiment
GSFC	Goddard Space Flight Center
GSTDN	Ground Station Tracking and Data Network
GWM	Guam STDN station

GLOSSARY (continued)

H

HAO	High Altitude Observatory
HAW	Hawaii STDN station
HGAS	High-gain antenna system
HSDL	High-speed data line
HV	High voltage
HVPS	High-voltage power supply
HXIS	Hard X-ray imaging spectrometer
HXRBS	Hard X-ray burst spectrometer

I

ICD	Interface control document
ID	Identifier, identity
*IP	Input processor (Telops module)
IP	Input processor system
IPC	Image proportional counter
IPD	Information Processing Division
IRU	Inertial reference unit
IT	Intermediate processor system
ITCS	Intermediate processor control system
ITP	Intermediate processor

J

JPL	Jet Propulsion Laboratory

K

kbps	Kilo-bits per second
keV	Kilo electron-volts
kg	Kilogram
kHz	KiloHertz
km	Kilometer
KSC	Kennedy Space Center

GLOSSARY (continued)

L

LMSC	Lockheed Missiles and Space Corp.
LOS	Loss of signal
LOX	Liquid oxygen
LSB	Least significant bit
LSD	Low-speed data

M

MBC	Message block count
MDB	Multiplex data bus
MECO	Main engine cutoff
MeV	Mega electron volts
MFW	Minor frame word
MHz	Megahertz
MICS	Management Information and Control System
MIL	Merritt Island STDN station
min	minute
MMS	Mulitmission Modular Spacecraft
MODE	Telemetry format mode
MOM	Missions Operations Manager
*MOV	Mover
MPC	Millisecond
mps	Meters per second
ms	Millisecond
MSB	Most significant bit
MSFC	Marshall Space Flight Center
MSS	Mass storage system
M & DOD	Missions and Data Operations Directorate

N

NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications Network
ND	Networks Directorate
NEPA	National Environmental Policy Act
NIP	NMCS Information Processing System
NMCS	National Military Command System Support Center
nmi	Nautical mile

GLOSSARY (continued)

NOCC	Network Operations Support Center
NOSP	Network Operations Support Plan
NRZ	Nonreturn to zero
NTTF	Network test and training facility
N/A	Not applicable

O

OBA	Optical bench assembly
OBC	Onboard computer
OCC	Operations Control Center
OCXO	Oven-controlled crystal oscillator
*OFU	Online file update
OSCD	Operational Support Computing Division
OSO	Orbiting Solar Observatory

P

PAD	Project Approval Document
PCM	Pulse Code Modulator
PCU	Power control unit
PDF	Project data format
PDP	Project Development Plan
PI	Principal Investigator
PM	Phase modulation
PMP	Premodulation Processor
POCC	Project Operations Control Center
POP	Project Operating Plan
PP	Project Plan
PRMF	Pre-planned mode
PRN	Pseudorandom noise
PRU	Power Regulation Unit
PSK	Phase shift keying
PSU	Power shifting unit

Q

QUI	Quito, Ecuador, STDN station

R

*REC	Record I/O
RF	Radio frequency
RHCP	Right-hand circular polarization
RIU	Remote interface unit
R&QA	Reliability and Quality Assurance

S

sec	Second
SCP	Stored Command Processor
SC&CU	Singal control and conditioning unit
SECO	Sustainer engine cutoff
SIRD	Support Instrumentation Requirements Document
SMM	Solar Maximum Mission
SQPSK	Staggered quadriphase shift keyed
SS	Space Sciences
STACC	Standard telemetry and command components
STDN	Space Tracking and Data Network
STS	Space Transportion System
ST&DS	Space Tracking and Data Systems
S/C	Spacecraft

T

T/A	Transition Adaptor
TBD	To be determined
TDRSS	Tracking and Data Relay Satellite System
temp	Temperature
TELOPS	Telemetry on-line processing system
TM	Telemetry
TR	Tape recorder
TRW	Thompson-Ramo Wooldridge, Inc.
TTY	Teletype
T and E	Test and Evaluations

GLOSSARY (continued)

U

UBT	Universal boattail
UCL	University College London
UNH	University of New Hampshire
USB	Unified S-Band
UTC	Universal time count
UV	Ultraviolet
UVSP	Hi resolution UV spectrometer/polarimeter

V

V	Volt
Vdc	Volts direct current

W

W	Watt
WL	Wavelength
WLCP	White light chronograph/polarimeter

X

XRP	X-ray polychromator instrument
XUV	Extreme ultra violet
XTR	Experiment (HAO) tape recorder

*Refers to subsystem program within the TELOPS Input Processor System.

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BIBLIOGRAPHY

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4. Data Processing Plan for High Energy Astronomy Observatory-B (HEAO-B), GSFC X-565-78-2, February 1978.